

RESEARCH ARTICLE

## THE USE OF BANANA CORM EXTRACT AND PHOSPHATE ROCK TO INCREASE AVAILABLE-P IN ALFISOLS

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### ABSTRACT

The aim of this research is to study the appropriate formula and applied method of banana corm and phosphate rock on available-P in Alfisols. The research was arranged in factorial completely randomized design with 3 factors. The first factor is the dosage of banana corm extract, which is consisted of: E1 = 100 ml of banana corm extract, E2 = 200 ml of banana corm extract, and E3 = 300 ml of banana corm extract. The second factor is the dosage of the phosphate rock which is consisted of B1 = 100 gr of phosphate rock, B2 = 200 gr phosphate rock, and B3 = 300 gr of phosphate rock. The third factor is application method, which is consisted of M1 = directly applied into the soil. M2 = incubated before applied into the soil. The observation of soil includes: soil pH, soil organic matter content, cation exchange capacity, total-N, total-P, available-P and the population of phosphate solubilizing bacteria. Result shows that available-P in the Alfisols is very low. The interaction amongs the treatment significantly affect the population of phosphate solubilizing bacteria. Banana corm extract and phosphate rock applied directly into the soil increase soil pH.

**Keywords:** banana corm extract; phosphate rock; available-P

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### INTRODUCTION

Phosphat (P) is one of the macro nutrient which is very important to grow the plants, even its amount in the plants is very low if it compare with the other nutrients, such as Nitrogen (N), Calcium (Ca), and Potassium (K). The reason is because P in the soil is bound with the form of Al-P, Fe-P, Ca-P, and Occluded-P. (Mansur et al., 2003)

The existence of cordage of P causes the fertilizer P given is not efficient. So that we need to give the high dosage. The less efficiency of the use of this fertilizer can be coped with many ways. Besides by adding the fertilizer P (i.e. SP 36), it also can be coped with by giving the the rockphosphate or by employing the Phosphate Solubilizing Bacteria as organic fertilizer.

One of the material which can be used to make organic fertilizer is the hump of banana. Actually, the hump of banana has so many important compounds to grow the plants such as Azospitillum, Azotobacter, Bacillus, Aspergillus, and the other phosphate solubilizing Bacteria. The giving of the fertilizer P from the rockphosphate which is given together with the organic fertilizer containing the banana's cormis hoped that it can increase the available-P in the soil because of the existence of bacteria's role, such as Pseudomonas which is capable to release P from its bound with Fe, Al, in alfisols, so that P is available. The available-P in the soil is very important to grow the plants.

The symptom of deficiency in nutrient P appear in the beginning of the growth of sweet corn, so that the distribution of fertilizer needs to conduct. Fertilizer as basic

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fertilizer should be given when plantation is conducted together with fertilizer of nitrogen and potassium.

## **MATERIALS AND METHOD**

This research has been conducted during April - November 2014 in greenhouse of Agriculture Faculty. Analysis is conducted in Lab. of Soil Chemistry and Fertility and Lab. of Soil Biology and Biotechnology of Agriculture Faculty of Sebelas Maret University. The purpose of this research is to gain the appropriate formulation from the banana's corm and the rockphosphate in the availability of P and to obtain the best way to give the banana's corm and the rockphosphate in the available-P.

The research is conducted by using factorial design of the complete random plan by using 3 factors. The first factor is the dosage of extract of banana's corm, which is consisted of: E1 = 100 ml of the extract of banana's corm, E2 = 200 ml of the extract of banana's corm, and E3 = 300 ml of the extract of banana's corm. The second factor is the dosage of the rockphosphate which is consisted of B1 = 100 gr of the rockphosphate, B2 = 200 gr the rockphosphate, and B3 = 300 gr the rockphosphate. The third factor is application method which is consisted of M1 = directly application of the extract of banana's corm and the rockphosphate into the soil. M2 = application of the extract of banana's corm and the rockphosphate which is through the incubation process before inserting into the soil. Each treatment is conducted three times.

The observation of the chemical characteristic of soil includes: soil pH, soil organic matter, cation exchange capacity, total N, total P, available-P and the population of the phosphate solubilizing bacteria. Data analysis used is F Test and DMRT to compare amongs the average of treatment.

## **RESULTS AND DISCUSSION**

### **The characteristic of the soil, phosphate rock and banana corm extract**

The analysis result of the soil characteristic, quality of the phosphate rock and the extract banana's corm used in the experiments is presented in table 1.

From table 1, it's found that Alfisols of Jumantono used in this research has low fertility. This fact is supported by the data analysis that pH is acids, soil organic matter is very low, N total and available-P is low. The content of the phosphate solubilizing bacteria which are in big amount (for about  $1 \times 10^5$  cfu), is hoped having ability in making the availability of the nutrient of P in the soil is effective because it able to release P from the bound of Fe and Al, so that P becomes available. The result of analysis to the content of total-N 0,09% and available-P is very low (0,091 ppm. According to Roesmarkan, A. And N,W.Yuwono (2002) shows the availability status of nutrient which can directly give as fertilizer in this study and it is hoped that it can increase the availability of P in the soil.

The analysis result MOL of the extract of banana's corm contains phosphate solubilizing bacteria as much as  $4 \times 10^5$  cfu, which is said by Wulandari (2011) that it has the fast and strong ability in solubilizing phosphate from the bound of Fe and Al, so that P becomes available. In order to increase the efficiency of the fertilizing treatment of P, we need to develop the ability of the phosphate solubilizing bacteria which is exist in the banana's corm in making the availability of the nutrient of P effective. By giving them together amongs the banana's corm and the rockphosphate, it is hoped that they can increase the available-P in the soil and can change the sintetic fertilizer SP36 because of the several overplus that they have.

**Table 1.** Soil Analysis, Quality of Rock Phosphate and Extract of Banana’s Corm.

No	Chemical Characteristic of Soil used	Result	Level
1	pH scale measures	4,69	Acid
2	BO (%)	1,08	Low
3	The capacity of kation alternation	7,7	Very low
4	N total (%)	0,22	Very low
5	P total (%)	0,097	Average
6	P available (ppm)	0,091	Very low
7	K available (me/100g)	0,28	Low
8	The phosphate solubilizing bacteria	$1 \times 10^5$	
No	Some characteristic of Phosphate Rock	Result	Level
1	pH	7,13	neutral
2	Total-P (%)	16	High
3	Available-P (ppm)	6,99	Very low
No	Some characteristic of Banana Corm Extract	Result	Level
1	pH	3,85	Acid
2	BO (%)	2,99	Average
3	Total of phosphate solubilizing bacteria (cfu)	$4 \times 10^5$	

Remarks : Analysis Result of the Agronomy Laboratorium, Faculty of Agriculture, Sebelas Maret University Surakarta (2014)

Level based on Hardjowigeno, S. (1995)., Roesmarkam, and N,W. Yuwono (2002) and PPT (1983)

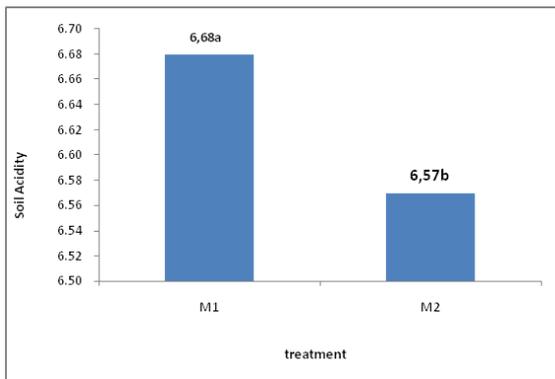
The result of chemical characteristic of the soil which is conducted in the last experiment, to the Alfisols of Sukosari after getting treatment by given the rockphosphate and the extract of banana’s corm, doesn’t show the same differences for every parameter.

The result of DMRT Test shows that the treatment’s influence as follows : application methode (M) has influence to the pH scales measures , the rockphosphate has influence to P total of the soils, the banana’s cormhas influence to the P-available of the soil, eventhough there is no interaction happened amongs these treatments. Interaction only happened when the population of the phosphate solubilizing bacteria gets the treatment of the banana’s cormand the rockthe phosphate.

In the observation of the pH of the soil which includes the avaibility of nutrient in the soil, the highest shows by application method of the banana’s cormand the rockphosphate by giving directly to the soil (M1), that is 6,68. Meanwhile, in application method of the banana’s cormand the rockphosphate by

conducting incubation in the beginning continued by inserting into the soil (M2) is 6,57. (Fig. 1)

The increase of high pH, is caused by the application method of the banana’s cormand the rockphosphate by giving directly into the soil (M1), it experience mineralization process of Ca which exist in fluoroapatit ( $Ca_5(PO_4)_3-F$ ). The rockphosphate is faster. It is caused by its alkalin characteristic of phosphate stone which is used is high, so that pH of the soil increases. Hue and Amin (1989) say that total concentration of kation alkali (Ca)which is mineralized in the soil will influence the increase of pH of  $H_2O$ . In the application method by conducting incubation in the beginning continued by inserting them to the soil (M2), is predicted having reaction process which decrease the pH of the mixture of the material which are used (the banana’s cormand the rockphosphate). The pH of the banana’s cormis very acid, that is 3,85, so that when it is given in the soil, it caused the pH of the soil does not change. The effect of the giving of the banana’s cormand the rockphosphate can increase pH of the soil, but

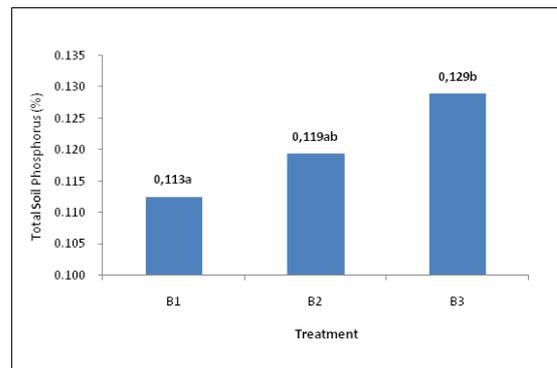


**Figure 1.** The effect of application method of the banana corm and the phosphate rock on soil pH

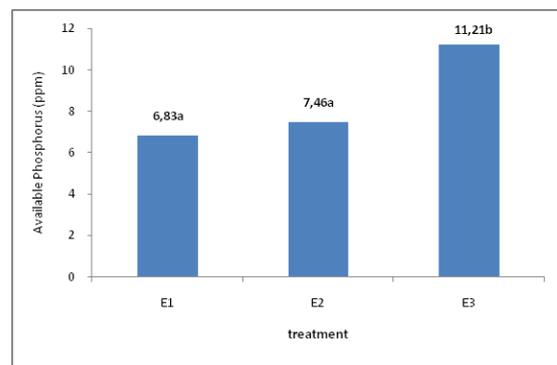
the amount of the increasing depends on the quality of the rockphosphate that is used. the rockphosphate has high Ca and high pH.

The change of pH is going to followed by the increase of P in the soil, either P total or P available in the soil. The observation result shows that the increase of P total of the soil happened by following the process of the increasing of the rockphosphate dosage that is used, meanwhile the increase of P available in the soil happened by following the process of the increase of the banana’s cormdosage. (Fig. 2 and Fig. 3)

Akande et al. (2005), explains that the increase of P total i the soil, is related to the adding of P into the soil. The analysis result to the content of P in the rockphosphate which is used is very high, that is 16%. This situation shows the contribution value of the nutrient P into the soil if it compares with the giving of the extract of banana’s corm. According to Akande, et al. (2005), the biggest the rockphosphate gives, the highest the amount of P adds into the soil. It is also happened to the P available. The increase of P available in the soil by giving the extract of banana’s corm, perhaps happened because of the role of bacteria, one of them is *Pseudomonas* which has an ability to release P from the bound of Fe, Al, in the Alfisols, so that P is



**Figure 2.** Effect of Rock Phosphate on total P

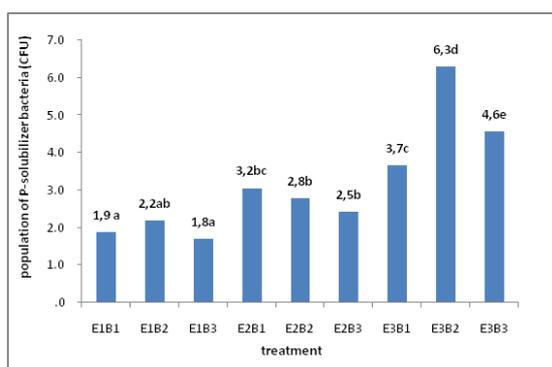


**Figure 3.** Effect extract Banana’ Corm on available-P

available. The solubility of P by *Pseudomonas* starts by secretion of organic acids which has function as catalisator, brace, astringent, and organic acids form a complex compound with kation-kation  $Fe^{2+}$  and  $Al^{3+}$ , so that there is the solubility of P into the form of available (Wulandari, 2001).

The available energy source and the enough nutrient from the process of treatment by giving the banana’s cormand the rockphosphate. This condition is going to influence to the increasing the population of the phosphate solubilizing bacteria. (Fig. 4)

The result of the observation shows that there is interaction amongs the treatments of the banana’s cormand the rockphosphate to the population of phosphate solubilizing bacteria. According to Hakim et al (1986), he says that by adding the organic material (in this case MOL of the hump extract) into the soil will increase the amount and the activities of soil



**Figure 4.** The effect of banana's corm and rock phosphate on population of the phosphate solubilizing bacteria

bacteria. Linier with Hakim et al, Subba Rao (1994) says that the phosphate solubilizing bacteria uses energy and carbon sources from the organic compound which is exist in the organic material, such as MOL of the hump of banana). Akande et al., says that the biggest amount of the rockphosphate is given, the highest amount of the P is added into the soil. This condition encourage the activities and the development of the population of phosphate solubilizing bacteria in conducting collubility process of phoshate of the rockphosphate. The giving of the banana's corm as MOL from the organic material and the giving of the rockphosphate are believed that they can provide the energy and carbon sources needed by the development of the population of the phosphate solubilizing bacteria.

## CONCLUSIONS

The nutrient P available in the Alfisols is very low. The increase of P total is caused by the treatment of the rockphosphate, meanwhile the increase of the level of P available is caused by the treatment to the banana's cormand there is not any interaction amongs the treatments. The interaction amongs the treatment only happened in increasing of the population of the phosphate solubilizing bacteria. the treatment application

of the banana's corm and the rockphosphate directly done by inserting into the soil influences to the increase of pH of the soil.

The giving of the mixture of the banana's corm and the phosphate rock is conducted by using the application method which is by inserting them directly into the soil because it is easier and more effective. For strengthen this result of the research, it needs more research by using kind and dosage of the organic fertilizer from MOL of the banana's corn from the other varieties.

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