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EFFECT OF BOKASHI BOTTOM ASH DOSAGES ON THE GROWTH OF VETIVER GRASS (*Vetiveria zizanioides*) AND ITS LEAD CONTENT

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ABSTRACT

The experiment was conducted at a greenhouse of Agricultural Faculty of Winaya Mukti University Tanjungsari Sumedang, West Java, from May to October 2009. The objective of this research was to see the effect of the bokashi bottom ash application on the growth and of vertiver grass and its lead content. The experiment used the environmental design of Randomized Block Design (RBD) that consist of five treatments and is repeated five times. The factor was the bokashi bottom ash dosages (0,5,10, 15, and 20 t ha^{-1}). The results show that the application of bokashi bottom ash affected the growth of vetiver grass, except shoot root ratio. The dosage of 15 t ha^{-1} presented a good effect to the plant height, the number of leaves and tillers. The bokashi bottom ash with dosage of 20 t ha^{-1} wasthe best effect in absorbing lead applied to vetiver grass.

Keywords: bottom ash, bokashi bottom ash, heavy metal Pb, vetiver grass

INTRODUCTION

Bottom ash is a coarse fraction produced from the coal burning furnace. Although it is often called as dangerous and poisonous waste, the ash has its own benefit. In the United State of America and India, bottom ash has been used as an efficient material in agriculture which is utilized as ameliorant (a substance to make the marginal soils better) to cultivate various kinds of plants (Kumar et al., 2000). Capp and Engle (1987) suggested that the ash from residual coal burnt can be utilized as a soil ameliorant and it has been tested to subtropical plants such as oats, wheat, and barley at Virginia University (Sondari and Arifin, 2000). The chemical substance in bottom ash is highly depended on coal source. Chemically, the bottom ash contains some nutrients, micro elements, which are highly potential and are necessary for various kinds of plants to growth (Sondari, 2005).

In this research, bottom ash was used to support the growth of vertiver grass. Vertiver grass an important plant to produce essensial oil which used widely in cosmetics industry (soap, toothpaste, shampoo, lotion), food industry as a flavoring ingredient / flavor enhancer, perfume industry, pharmaceutical industry and medicine, preservatives, and insecticides (Taryana, 2008). The vetiver grass comes from India, Southeast Asia and The Tropical Africa (Bertea and Comuso, 2002 in Hobir, et al., 2006) and now more than 100 countries use and plant vetiver grass, for the production of essential oils or as a plant holder and rehabilitation of soil erosion (Xiurong et al., 2003 in Hobir et al., 2006).

Although the vetiver grass is a tropical plant, the plant can also grow is an area that has temp. of 0-45°C and average annual rainfall of 300-6000 mm (Hengchaovanich, 1996 in Carey, 2000). Vetiver grass is known to be tolerant to heavy metals such as copper, nickel, chromium, aluminum, cadmium and arsenic (Troung, 1999a in Carey, 2000). It is more tolerant to the heavy metals Pb which has been tested in the mining area (Shu et al., 1999 in Carey, 2000). Due to its tolerant nature to heavy metal, vertiver grass is used as an accumulator plant for contaminated land.

Bokashi is one of organic manure, composts, produced by of organic substance fermentation using EM (Effective Microorganism) technology (Ritapunto, 2008). Bokashi bottom ash can give a

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positive contribution to the soil and plant. However, the bottom ash contains oxides heavy metal. One of them is lead (Pb). In low levels, the metal is poisonous to the plants and animals, including human. Lead will be accumulated in the environment and is not biodegradable. Its toxicity is not changed over time. Based on that fact, in this research, bokashi bottom ash was used to support the growth of vertiver grass and to know its response as accumulator plant of Pb.

METHODOLOGY

Materials used in this experiment were Vetiver grass (*Vetivera zizanioides*), andisol soil, bokashi bottom ash (bottom ash, chicken manure, rice husks, straw, bran, EM 4, sugar water, and water), urea (45% N), Super Poshpate SP-36 (36% P_2O_5), KCl (Pottasium Chloride)(60% K_2O), Fungisida Dithane M-45 80 WP and Furadan 3G Insecticide. The composition of bokashi bottom ash was analyzed at Agro Chemical Laboratory, Lembang.

The experiment used the environmental design of Randomized Block Design (RBD), consisting of 5 of dosage treatments (0, 5, 10, 15, and 20 t ha^{-1} of bokashi bottom ash) and was repeated in 5 times.

The data of plant height, number of leaves, number of tiller, shoot root ratio, Pb content of plant, and level of heavy metal within plant, were analyzed by the F test with 5% significant level and Duncan's Multiple Range Test. Determination of heavy metals in plants employed HNO_3 and $HClO_4$ of dry ashing.

RESULTS AND DISCUSSION

The Plant Height

Chemical analysis of bokashi bottom ash shows the MgO = 1,527 % ; CaO = 5,376 % ; K_2O = 0,57 % ; Zn = 0,0058 % ; Cu = 0,0014 %, Fe total = 1,7078 %. Result of different treatment test is shown in Figure 1. It can be seen that the growth of vertiver grass without the application of bokashi bottom ash shows the lowest plant height. The seven curves in Figure 1 indicated similar quadratic regression. From DAP (day after planting) 21 until 105 the plant height increased slowly.

The application of bokashi bottom ash 5 - 20 t ha^{-1} provided increasing plant height compared to control (0 t ha^{-1}). However, at DAP 21, the dosage of 5 t ha^{-1} was not significantly different from control, and at DAP 35 , the dosage of 20 t ha^{-1} was not significantly different from control. The application of bokashi bottom ash up to 15 t ha^{-1} increased the plant height but it decreased when the dosage of 20 t ha^{-1} was added at the age of DAP 35. Probably, this is related to the absorption of macro nutrients by the plants that has reached the optimum point, so the addition of organic substances did not give any effect to the plants.

The contribution of nutrients from bokashi bottom ash occurred because of decomposition and mineralization. This is in a line with Sondari (2005) who found that the application of 10 t ha^{-1} bokashi bottom ash accompanied with 15 t ha^{-1} green manure increased the growth of hermada (*Shorgum bicolor* L. Moench), because it can improve the chemical and physical properties of utisols soil, improved CEC (Cation Exchange Capacity) from 14 c mol (+) kg^{-1} to 20 c mol (+) kg^{-1} and also improved the availability of other nutrients. It also decreased Al saturation, increased P absorption, so the plants can grow better.

The Number of Leaves

Result of different treatment test is shown in Figure 2. There were significant differences of leave between control and other treatments at all observation time. The growth of vertiver grass without the application of bokashi bottom ash gave the lowest number of leaves. Bokashi bottom ash can improve the physical, chemical, and biological properties of the soil. The role of bokashi bottom ash in improving the physical properties of the soil leads to the good soil's porosity. The soil becomes loose and the roots can grow better. To absorb more effective elements as a result, it stimulates the plant growth, including the growth of leaves.

The Number of Tillers

Result of different treatment test to the number of tillers is shown in Figure 3. **T**he number of tillers in vetiver grass was highly affected by the photosynthesis process and nutrients. Bokashi bottom ash contains both micro and macro nutrients. In andisols soil with pH of 5,2, the available N, P and K are very low. The addition of bokashi bottom

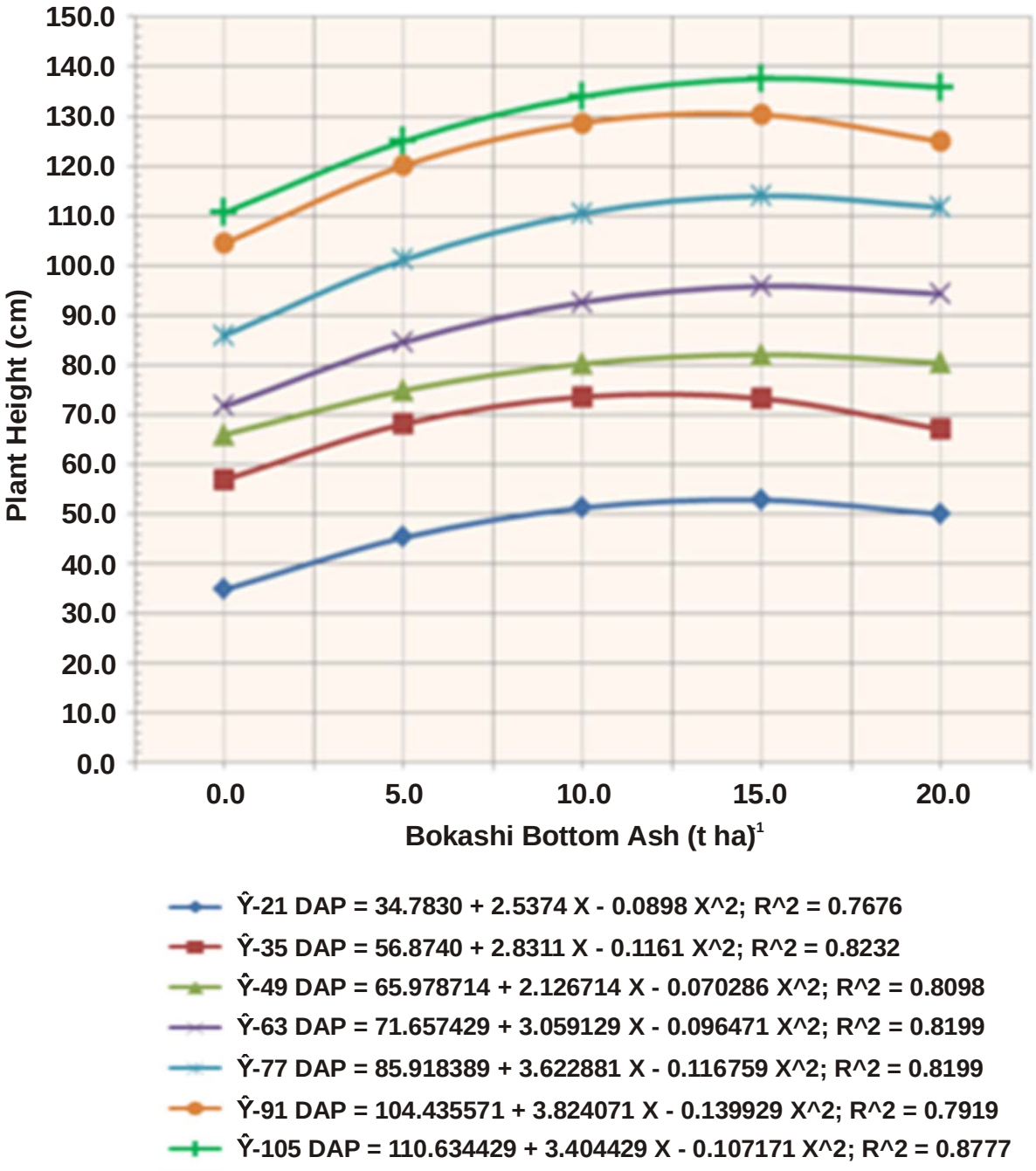

Figure 1. Effect of bokashi bottom ash on plant height

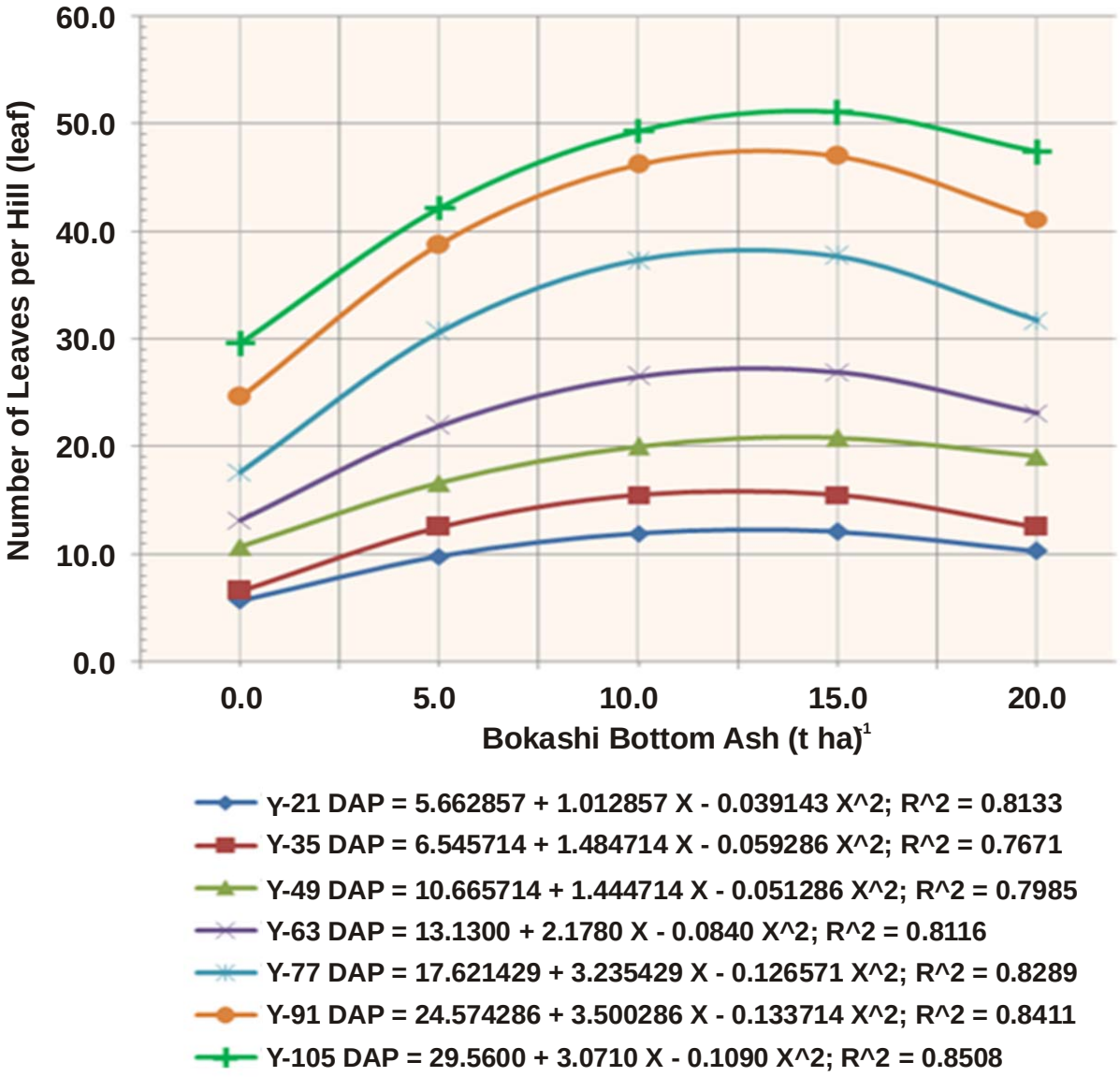

Figure 2. Effect of bokashi bottom ash on the number of leaves

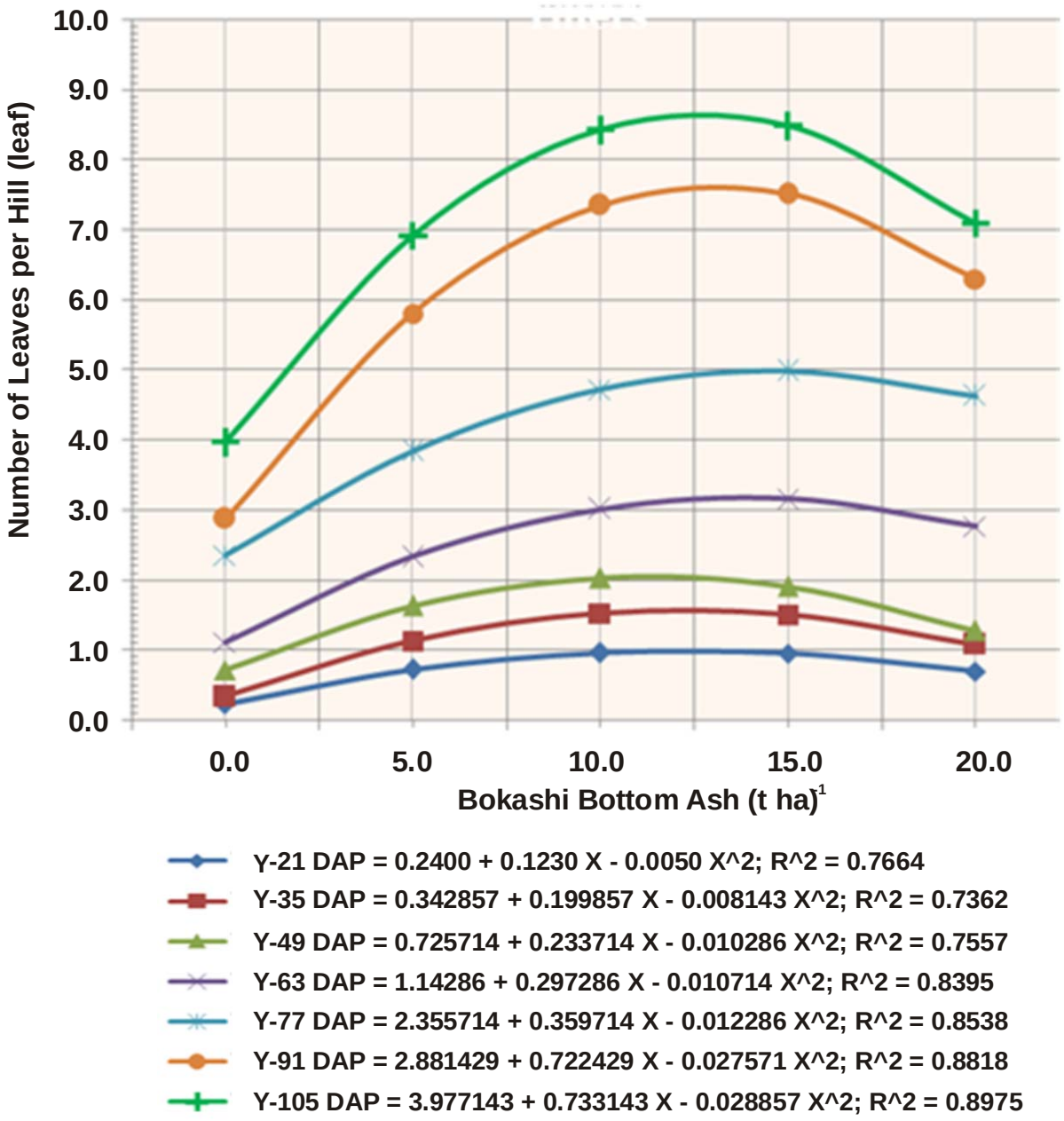

Figure 3. Effect of bokashi bottom ash on the number of tillers

ash can improve soil fertility, and increase the growth of tillers of the plant.

Without the application of bokashi bottom ash (0 t ha^{-1}), vertiver grass produced less tillers than the other dosages (5, 10, 15, and 20 t ha^{-1}). The application of bokashi bottom ash to the soil makes better physical properties of the soil. Observation on the ages from DAP 21 until 105 shows the increase curve regression at the beginning, then it increase sharply with the increase of bokashi dosage.

According to Hardjowigeno (2003), organic substance makes soil processing easier. The aggregates formation of mineral grains causes loose condition, be able to store water, increase total porosity, decrease weight content of the soil so the soil can hold water longer. The application of bokashi bottom ash holds up the soil permeability, and water availability that result in increasing the number of tillers.

Shoot Root Ratio

Result of different treatment test to shoot root ratio is shown in Table 1.

Table 1. shows that the application of bokashi bottom ash dosage did not give any difference to shoot root ratio. Probably, the nutrients absorbed by the vertiver grass were sufficient so the shoot root ratios were relatively similar.

Lead Content

Result of different treatment test to the Pb content is shown in Figure 4. It can be seen that the application of bokashi bottom ash increases the lead content with liniar curve. This result supports the idea that the vetiver grass is an accumulator for Pb. Therefore, it can be used for land remediation polluted by Pb (Roechan et al., 2000).

Table 1. Effect of bokashi bottom ash dosage on shoot root ratio

Treatment (t ha^{-1})	Shoot Root Ratio
0	1,459 a
5	1,426 a
10	1,430 a
15	1,417 a
20	1,427 a

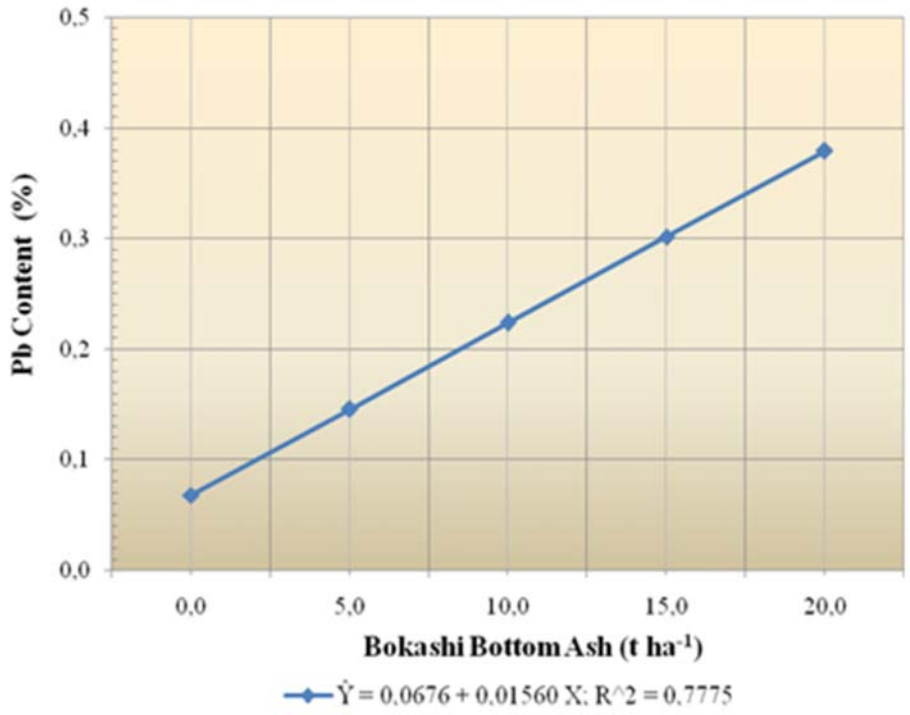

Figure 4. Effect of bokashi bottom ash dosage on Pb content of vertitiver grass

CONCLUSIONS AND SUGGESTIONS

Conclusion

The application of bokashi bottom ash affected the growth of vetiver grass. The dosage of 15 t ha^{-1} gave a good effect to the plant height, the number of leaves, and the number of tillers. Bokashi bottom ash with the highest dosage of 20 t ha^{-1} contributed to the greater absorption of Pb by vetiver grass as Pb hyperaccumulator.

Suggestion

To support the growth of vetiver grass, it is better use bokashi bottom ash at the dosage of 15 t ha^{-1}, however for reclamating the land polluted by Pb, it is recommended using bokashi bottom ash at the dosage of 20 t ha^{-1}.

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