Available online at:
http://journal.unila.ac.id/index.php/tropicalsoil
DOI: 10.5400/jts.2017.22.2.51

The Utilization of Bottom ash and Cow Manure Compost as Soil Ameliorant on Acid Mineral Soil and its Effects on Mustard (*Brassica Juncea*)

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Received 08 September 2016/ accepted 26 December 2016

ABSTRACT

Bottom ash and cow manure compost can be used as soil ameliorant. Bottom ash and cow manure compost can improve the soil chemical properties, such as increasing pH and the levels of nutrients availability in the soil. Thus, the objective of this study was to assess the effect of bottom ash and cow manure compost on the improvement of soil chemical characteristic as well as the levels of heavy metals in soils and mustard. This study was conducted in Greenhouse, involving three treatment factors; aged bottom ash (fresh, 4 months and 2 years), the dose of bottom ash, i.e. 0, 40 and 80 tons/ha, and the dose of cow manure compost, i.e 0 and 10 tons/ha. The results showed that the addition of bottom ash and cow manure compost increase the soil pH, total-N, available-P and exchangeable cations (K, Ca and Mg). The addition of bottom ash 40 and 80 tons/ha increase levels of Pb, Cd and Co of the soil, but not with Pb and Co at the plants, while the cow manure compost 10 tons/ha increase level of Cd in soils and plants. However, the whole treatments on the plants and soils showed that low heavy metal was classified.

Keywords: acid mineral soil, bottom ash, compost, heavy metal, landfills

INTRODUCTION

Coal ash is the waste from the combustion of coal. Coal ash based on the size of the particle can be divided into the fly ash and bottom ash. Coal combustion produces about 5% ash which consists of 80-90% fly ash and 10-20% bottom ash. Based on the thermal of Indonesian power plant, coal ashes resulted in 2006 amounted to 2 million tons (Aziz *et al.* 2006) and continuously grow every year resulting in the accumulation of coal ash waste in landfill.

The utilization of coal ash in Indonesia are regulated by Government Regulation No. 101/ 2014 which classifies coal ash, either fly ash or bottom ash, as one of B3 waste (hazardous and toxic substances), thus in the utilization must be tested by The Toxicity Characteristic Leaching Procedure (TCLP). The regulation is an obstacle to utilization of coal ash as soil ameliorant. In addition, the research on the utilization of coal ash for improvement of soil quality used more fly ash that is smoother, compared to bottom ash. The particle of size bottom ash is approximately 0.1 – 10 mm (Korcak 1995), while the fly ash has a very fine particle size, which is only around 0.01-100 ìm and porous that contributes to facilitate leaching cations (Haynes 2009).

Bottom ash contains macro nutrients (P, K, Ca, Mg, and S) and micro nutrients (Fe, Mn, Zn and Cu) (Park *et al.* 2012). The addition of coal ash can increase the value soil of pH, the available-P and the availability of base cations on peat soil (Iskandar *et al.* 2008). The pH affects the mobility and solubility of essential and non-essential metals in the soil (Haynes 2009).

Another potential soil ameliorant is organic matters. Organic matters can increase the cation exchange capacity (CEC), affect the pH and increase the availability of nutrient elements in soil organic matters, as it is the source of energy for the microorganisms in the soil (Stevenson, 1982). Organic matter that used in this research is cow manure compost.

Utilization of bottom ash is potential to develop acid mineral soil in increasing agricultural productivity. Inceptisols are one of the soil type which have the fertility and chemical properties that are relatively low pH about 4.5 and base saturation of low to medium (Sudirja *et al.* 2007). Inceptisols occupy about 40% or 70.52 millions ha of the total