Determination of Soluble Phosphorus Content in Black Walnut Husk Compost via Formation of Molybdenum Blue

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Abstract. Walnut fruit husk compost is a by-product of the commercial processing of walnuts. These outer husks collect into generous size piles and are normally left to decompose. Black walnut (*Juglans nigra*) husk compost was analyzed for phosphorus content to determine its potential as a phosphorus fertilizer or soil additive. Twenty-two samples of walnut husk compost of varying decomposition times were collected and dried. Soluble phosphate was extracted with distilled water and reacted with ammonium molybdate and stannous chloride to form the brightly blue-colored heteropoly-molybdenum blue which was analyzed spectrophotometrically at 650 nm. Soluble phosphorus (as mass percent of dried samples) decreased by nearly 50 percent in the first year from 0.1708 ± 0.0199 percent in three-week-old compost (n = 7) to 0.0967 ± 0.0099 percent in 52-week-old compost (n = 8). In conclusion, the water soluble phosphorus found in walnut husk compost is within a suitable range for plant usage, but as a fertilizer it would be very mild. Due to the known allelopathic effects of this species, this level of phosphorus might make such compost an acceptable candidate for herbicidal applications with concurrent fertilizing benefits.

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INTRODUCTION

Black walnut trees (*Juglans nigra*) are grown in Southeast Ohio for the production of high quality walnut kernels. These kernels are most frequently removed mechanically by the use of cracking machines (Koyuncu and others 2004). A by-product of this kernel extraction process is the outer husk of the walnut, which collects in very large amounts at processing facilities. These walnut husks are often left to decompose on-site. Identification of commercial markets for this material would be of interest to processing companies. The objective of this study was to determine the phosphorus content in walnut husk compost for potential fertilizer or soil modification applicability.

MATERIALS AND METHODS

Twenty-two samples of walnut husk compost of varying decomposition times were collected from the Integration Acres farm in Albany, OH. Compost samples were collected from three weeks post-cracking (n = 7), 46 weeks post-cracking (n = 7) and 52 weeks post-cracking (n = 8). Samples were dried at 25°C, crushed with mortar and pestle and massed. Soluble phosphorus was then extracted with distilled water over a two-week period. Soluble phosphorus was determined via formation of molybdenum blue by reacting with ammonium molybdate, $(NH_4)_6Mo_7O_{24}$, and stannous chloride, $SnCl_2$, to form the brightly blue-colored heteropoly-molybdenum blue (Wei and others 2009). The characteristic blue color is believed to be attributed to a mixed-valence complex formed when the near-colorless anion, predominantly the phosphomolybdate anion, $PMo_{12}O_{40}^{3-}$, is further reduced through a reversible one or two electron transfer process (Greenwood and Earnshaw 1997). This complex was analyzed at 650 nm using a Shimadzu UV-2550 UV-Vis spectrophotometer. Calibration of the method was achieved using standard solutions of potassium dihydrogen phosphate, KH_2PO_4 (purchased from Sigma Aldrich) in reaction with ammonium molybdate and stannous chloride. The resulting plot (Fig. 1) exhibited a linear regression coefficient of $R^2 > 0.99$ (n = 6).

RESULTS

Soluble phosphorus (as mass percent of dried samples) decreased by nearly 50 percent in the first year from 0.1708 ± 0.0199 percent in three-week-old compost (n = 7) to 0.1282 ± 0.0113 percent in 46-week-old compost (n = 7) to 0.0967 ± 0.0099 percent in 52-week-old compost (n = 8).

DISCUSSION

Water-soluble phosphorus has been shown to be predominantly in organic form after release from microbial biomass in the soil (Turner and Haygarth 2001). Organic phosphorus is an important component of soil biogeochemical cycles, and although most forms of organic phosphorus are not water soluble (Turner and others 2005), the necessity for water soluble forms of phosphorus in fertilizers has been demonstrated (Archer and Thomas 1956). The water soluble phosphorus content in walnut husk compost was within a suitable range for plant usage, yet would serve only as a mild phosphorus fertilizer. Further studies are necessary to determine its potential as a nitrogen, potassium and/or micronutrient

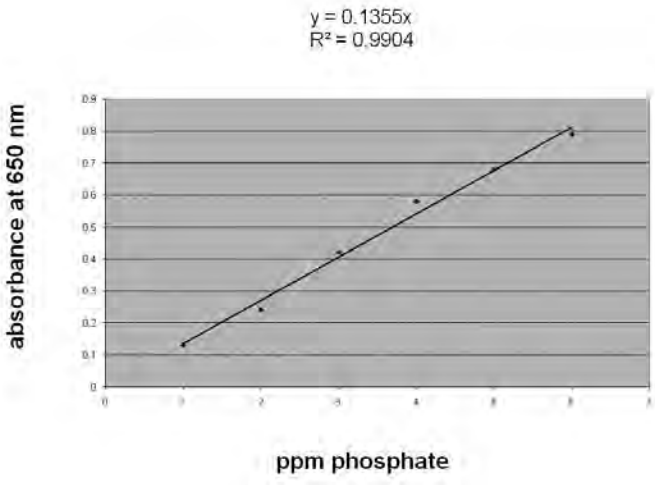

Figure 1. Calibration plot of standard solutions of potassium dihydrogen phosphate, KH_2PO_4, in reaction with ammonium molybdate and stannous chloride. Absorbances were measured at 650 nm.

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fertilizer. Due to the known allelopathic effects of this species (Rietveld 1983), this soluble phosphorus content might make such compost an acceptable candidate for herbicidal applications with concurrent fertilizing benefits. In addition to herbicidal purposes, walnut husk compost could also be applied as a soil additive for texture or physical make-up and could potentially also serve as a worm-casting substitute.

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