EFFECT OF POULTRY LITTER-YARD WASTE COMPOST APPLICATION ON PHOSPHORUS AVAILABILITY IN DIVERSE SOILS

by

Regine N. Mankolo

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APPROVED:

David C. Martens
Co-Chairman

James R. McKenna
Co-Chairman

James C. Baker

Julian D. Brake

Ronald D. Morse

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Dr. David C. Martens, Co-chair

Dr. James R. McKenna, Co-chair

(ABSTRACT)

Land application of poultry litter has been successfully practiced for centuries to maintain and improve soil fertility, although over application may promote loss of nutrients through runoff or leaching. To decrease the potential for adverse environmental impacts of N and P in groundwater, a new approach developed in this research was to use a composted mixture of poultry litter (PL) and yard waste (YW) as a soil amendment for corn (*Zea mays L.*) production. Objectives of this research were to evaluate effects of pre-compost C:N substrate ratios for poultry litter-yard waste compost (PYC) on the availability of soil P, to determine the P response of corn plants to inorganic P, PL and PYC application, and to study relationships between P availability and both inorganic P and PYC application.

Langmuir isotherms were used in this research to select soils with relatively high P fixation capacities. Phosphorus sorption maximum for soils evaluated were as follows: 304 and 449 μg P g^{-1} for A horizon Coastal Plain soils (Series: Kempsville and Myatt, respectively); 487 μg P g^{-1} for an A horizon Ridge and Valley soil (Series: Frederick); 918 and 603 μg P g^{-1} for A horizon Piedmont soils (Series: Elioak and Vance, respectively); 1099 μg P g^{-1} for mine tailings (Series: Emporia located in the Coastal Plain); and 1524 μg P g^{-1} for A and upper mixed horizon soil (Series: Starr from Piedmont region). Based on intermediate to high P sorption maxima, soil from

the Vance and Starr series and mine tailing from Emporia series were selected for greenhouse research to evaluate P availability of PYC .

Treatments applied to the soil in the greenhouse and field studies consisted of various levels of P as $Ca(H_2PO_4)_2.H_2O$, PL and PYC from 15:1, 20:1, and 25:1 C:N ratio substrates. Each P source increased dry weight of corn plants grown in the greenhouse by alleviation of P deficiency. Phosphorus uptake from PYC and PL application was either equal to or higher than P uptake from an equal level of P application as $Ca(H_2PO_4)_2.H_2O$. Application of 87.2 kg P ha^{-1} increased corn grain yields in a field experiment on Vance sandy loam from 6340 kg ha^{-1} on the control to a range of 10,170 to 11,350 kg ha^{-1} for PYC digested from the three C:N ratio substrates.

The yields on PYC treatments were attributed to a combination of factors including slow mineralization of P with less fixation during the growing season. The low P fixing capacity results from the blockage of $H_2PO_4^-$ sorption by competition of negative charge from organic material and from the displacement of $H_2PO_4^-$ in soil solution by OH^- from application of the alkaline composts. It would be desirable from the standpoint of more PL utilization to prepare composts from low substrate ratio substrates. Hence, in this research composts were prepared from 15:1, 20:1, and 25:1 C:N substrates, which consisted of PL and YW. The composting process was complete after only four months for the PYC from the 20:1 and 25:1 C:N ratio substrates. Yard waste compost without PL may require somewhere between two to three years for complete composting as opposed to four months with PL addition. The composting was incomplete in four months (presence of undigested leaves and NH_3) for the PYC from the 15:1 C:N ratio substrate. The latter compost resembled poultry manure rather than a high quality compost after the 4-month composting period.

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DEDICATION

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