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Evaluating manure management interventions for fertiliser quality and zoonotic pathogens in pig manure, Uganda

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Abstract

The expanding pig subsector in Uganda, particularly among smallholder farmers, has increased the production of pig manure. While this represents a valuable nutrient resource amid rising fertiliser costs, poor management reduces its fertiliser quality and increases risks of nutrient losses and zoonotic pathogen transmission. However, evidence on effective pig manure management strategies under Ugandan field conditions remains limited. This study assessed low-cost interventions aimed at improving fertiliser quality and reducing zoonotic pathogens. On-farm experiments were conducted using separated solid and liquid pig manure fractions. Solid manure was managed through heap composting for 85 days under shelter, while liquid manure was stored in plastic containers under covered and uncovered conditions. Solid manure treatments were arranged in a randomised complete block design and included: (i) covering and turning, (ii) covering, turning, and biochar addition, and (iii) an uncovered, unturned control. Solid manure heaps were turned every three days during the first 15 days. Regular sampling was conducted to assess nutrient composition (total nitrogen, potassium, phosphorus, dry matter, organic carbon, pH, and ammonium and nitrate nitrogen) and pathogen indicators (Escherichia coli, Enterococci, and Salmonella). Fertiliser quality was further assessed through percentage nutrient loss estimates, and maturity indices including C:N ratio, germination index, and ammonium-to-nitrate ratio.

Data were analysed using linear mixed-effects models, ANOVA, Tukey HSD tests, and non-parametric tests (descriptive statistics and linear regression) for pathogen data. By day 85, no significant differences were observed among treatments for most nutrient parameters, except dry matter content, which was significantly lower in the uncovered, unturned treatment ($p = 0.002$). In liquid manure, total nitrogen and ammonium nitrogen differed significantly ($p < 0.05$), with covered storage retaining higher total nitrogen and lower ammonium nitrogen than uncovered storage. No treatment achieved full compost maturity based on maturity indices. Pathogen loads declined across all treatments, with moisture and temperature significantly influencing pathogen concentrations. This study showed

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that covering and turning of manure during composting, with or without biochar addition, showed potential as low-cost strategies to improve nitrogen retention and reduce pathogen risks, thereby enhancing the agronomic value and biosafety of pig manure in smallholder systems in Uganda .

Keywords: Biochar, composting, nutrient cycling, nutrient losses, pathogen reduction