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Introduction

Generally, compost application rates have been determined on the basis of the nitrogen (N) needs of crops. In most cases, this strategy has led to the accumulation of soil phosphate (P), due to the lower N/P ratios of animal manure composts than those of crop requirements. The excessive build-up of soil P increases the risk for P outflow from agricultural lands and eutrophication of surface waters. Phosphate-based compost application system based on the P fertilization recommendation and available P contents of composts, is effective for mitigating the soil P build-up. Estimating the available P of composts is inevitable for the P-based compost management but it has not been established. The objectives of this study were to evaluate the available P fraction of animal manure composts and compare those in upland soil and paddy soil by the combination of P composition analysis and a pot experiment.

Materials and Methods

Phosphate characterization analysis was conducted by the sequential extraction method of Frossard et al. (1996). Inorganic P was sequentially extracted by water, 0.5M $NaHCO_3$, 0.1M NaOH and 1M HCl with a sample/solution ratio of 1:200 for 16 hours. Cattle, swine and poultry manure composts with different P compositions were used for crop cultivation experiments. Twelve or 17 composts were added to the test pots so that the applied amounts of total phosphate were 0.32 or 0.25 g P_2O_5/pot, for growing tests of upland crop or paddy rice, respectively. Upland crop, corn (*Zea mays* L. cv. Pioneer 3352), was grown in a 2 L pot with 1.2 kg soil (subsurface soil of Fulvisol) for 32 days in a green house. Paddy rice (*Oryza sativa* L. cv. Hitomebore) was grown in a 4 L pot with 2.5 kg soil (subsurface soil of Andosol) for 54 days in a green house. The growing tests were conducted under sufficient nitrogen and potassium with 3 replications. After harvesting, P taken up by crops was determined. Relationships between P uptake of each crop and P fractions of composts were investigated by regression analysis.

Results

Phosphate taken up by corn ranged from 22 to 40 mg P_2O_5/pot and showed the closest correlation with the sum of water and 0.5M $NaHCO_3$ extractable P ($r=0.76^{**}$, n=12) among the various P fractions of the composts. Paddy rice absorbed P in a range of 2.4 to 33 mg P_2O_5/pot. Phosphate uptake of rice showed the highest correlation with the sum of water, 0.5M $NaHCO_3$, 0.1M NaOH and 1M HCl extractable P of the composts ($r=0.73^{***}$, n=17) . As shown by Ito et al. (2004, 2007), among the P fractions of animal manure composts, the sum of water and 0.5M $NaHCO_3$ extractable P was available for upland crops, on the other hand the sum of water, 0.5M $NaHCO_3$, 0.1M NaOH and 1M HCl extractable P was available for paddy rice. Availability of compost P was higher for paddy rice relative to upland crops. The reason is considered to be root-induced solubilization of P in the paddy rice rhizosphere by acidification due to ammonium ion uptake and proton release by rice roots (Saleque and Kirk, 1995).