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Formulation, utilisation and evaluation of organomineral fertilisers

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ABSTRACT

The water industry recognises significant cost advantages in recycling sewage sludge (biosolids) to agricultural land compared with alternative more expensive disposal options such as incineration or landfill. A recent technique was proposed by United Utilities plc for the production of organomineral fertilisers (OMF) from biosolids granules which adds additional nitrogen to the biosolids' nutrients to form a balanced NPK fertiliser. The aim of this research was to determine the effects in cereal and grass crops of using organomineral fertilisers (OMF) made from nutrients-enriched biosolids granules and to contribute towards the understanding of nutrient management and dynamics in agricultural systems. The research included soil incubation, glasshouse, lysimeters and field studies which used winter wheat (*Triticum aestivum L.*) and ryegrass (*Lolium perenne L.*). A theoretical model was developed for fertiliser particle distribution studies which required the determination of key physical properties of the products. Two OMF formulations have been suggested: OMF_{10} and OMF_{15} which have the following NPK compositions: 10:4:4 and 15:4:4 respectively. These were suggested for use in grassland as well as arable cropping. The particle trajectory model showed that the particle size range for OMF_{10} and OMF_{15} should be between 1.10 and 5.50 mm and between 1.05 and 5.30 mm in diameter respectively. The incubation studies showed that the greatest rate of nitrogen release from OMF_{15} (% total-N applied) occurred in the first 30 days following soil application (range of *c*.40% to 70%) with a further *c*.10% to 25% in the following 60-90 days depending on the soil type. The glasshouse studies showed that grass responses to nitrogen were initially in the range of 14 to 20 kg [DM] ha^{-1} per kg of additional nitrogen but they decreased by *c*.40-50% in 2008 and 2009. In the field studies, mean grain yields of winter wheat were *c*.7815 kg ha^{-1} (OMF_{10}) and *c*.8600 kg ha^{-1} (OMF_{15}); these were approximately 11% and 23% higher than biosolids- and between 30% and 20% lower than urea-treated crop respectively. The most economic rate of nitrogen application (MERN) for winter wheat, across the four crop seasons, were 257 and 248 kg [N] ha^{-1} with the use of OMF_{10} and OMF_{15} respectively. The use of OMF did not change soil extractable-P levels significantly in both the field and glasshouse experiments; hence, soil-P indexes remained closed to constant which was therefore supporting the reasons for the initial formulations. There is a need to improve the quality control for physical and chemical properties of OMF and to conduct spreading tests that may enable application at 18 or 24 m wide tramlines. The logistics of applying a straight nitrogen source as the first fertiliser dressing (late February to middle of March), and the balance of the application with OMF approximately 30 to 40 days later (early April) should be considered. Given the characteristics of the yield to nitrogen response curves, it is unlikely that OMF can be competitively priced. If the gross margin received by the farmer is to be unaffected by the fertiliser choice, the product will need to be subsidised. Given the assumptions made in the scenario it would be still an economic proposition for United Utilities plc to do this when compared with the costs of other disposal options. From this, there appears to be potential for further development of OMF products.