Geophysical Research Abstracts
Vol. 16, EGU2014-11932, 2014
EGU General Assembly 2014

Efficient nitrogen recycling through sustainable use of organic wastes in agriculture – an Australian case study

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The effective recycling of nutrients in treated sewage sludge (biosolids) domestic (e.g. source separated food waste), agricultural, and commercial and industrial (C&I) biowastes (e.g. food industry wastes, papermill sludge) for use on land, generally following treatment (e.g. composting, anaerobic digestion or thermal conversion technologies) as alternatives to conventional mineral fertilisers in Australia can have economic benefits, ensure food security, and close the nutrient loop. In excess of 75% of Australian agricultural soils have less than 1% organic matter (OM), and, with 40 million tonnes of solid waste per year potentially available as a source of OM, biowastes also build soil carbon (C) stocks that improve soil structure, fertility and productivity, and enhance soil ecosystem services.

In recent years, the increasing cost of conventional mineral fertilisers, combined with changing weather patterns have placed additional pressure on regional and rural communities. Nitrogen (N) is generally the most limiting nutrient to crop production, and the high-energy required and GHGs associated with its manufacture mean that, additionally, it is critical to use N efficiently and recycle N resources where possible.

Biosolids and biowastes have highly variable organic matter (OM) and nutrient contents, with N often present in a variety of forms only some of which are plant-available. The N value is further influenced by treatment process, storage and fundamental soil processes. The correct management of N in biowastes is essential to reduce environmental losses through leaching or runoff and negative impacts on drinking water sources and aquatic ecosystems. Gaseous N emissions also impact upon atmospheric quality and climate change. Despite the body of work to investigate N supply from biosolids, recent findings indicate that historic and current management of agricultural applications of N from biosolids and biowastes in Australia may still be inefficient leading to nutrient losses to air and water.

This paper discusses the sustainable recycling N resources in biosolids and biowastes in agriculture in Australia using specific recent research examples from Western Australia, including lime amended biosolids, alum sludge and dewatered biosolids cake, and from Tasmania, papermill sludge. The primary focus is the N fertiliser replacement value of different biosolids and biowaste types under different environmental conditions, and management issues relating to the sustainable recycling of N. Experimental work included field trials and soil incubation studies. The findings are compared with research findings conducted in different climatic regions and soil types across Australia (Queensland, Victoria, New South Wales) and internationally.