Biosolids as a source of phosphorus in Australian agriculture

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Introduction

The land application of biosolids (stabilised sewage sludge) in Australia accounts for 70% of end-use options returning approximately 6,000 tonne of phosphorus (P) to the soil annually for food production. The mean total P content of biosolids in Australia varies from 1.3 – 3.9% and is dependent on wastewater treatment. The P forms in biosolids are typically inorganic (88%) and often relcalcitrant.

The aim of our research was to investigate the phytoavailability of several different biosolids types used in Western Australia as a source of P for plant growth.

1. Biosolids (Total P=2.5%, dewatered & mesophilic anaerobic digestion). The phytoavailability of biosolids P was similar to monocalcium phosphate (MCP) at equivalent total P loadings measured in wheat shoots over three consecutive harvests in a P deficient sand in the glasshouse (Figure 1). In field experiments in P deficient sand, the relative effectiveness of biosolids P was 68% of equivalent inorganic P for dryland wheat grain production and 62% in the second season. This was reduced to 39% where the biosolids were not fully incorporated into the soil. All other nutrients were supplied in basal amounts.

2. Lime amended biosolids (LAB) (Total P=1%, addition of quicklime: CaO) post-treatment to secondary sludge to destroy pathogens). The field experiment over three years indicated that grain yield of dryland wheat in LAB at 5.2 t DS/ha on an acidic loamy sand ranged from 84 (year 1) to 66% (year 3) relative to the most comparative inorganic P fertiliser and lime treatment.

3. Alum sludge (AS) (Total P=3.9%, aluminium sulphate added to precipitate P). Grain yield of dryland wheat in the AS treatment applied at an equivalent available N rate to the inorganic fertiliser was 62% (year 1) and 69% (year 2) of the yield achieved by fertiliser treatment. No toxic forms of aluminium were detected in the soil at any rate of AS application. Plant shoot tissue analysis indicated that wheat sown in the AS treatments were P deficient, but adequate in the inorganic fertiliser treatment. There was no other nutrient deficiency. Amendment with AS increased soil P, however the forms of P present in alum sludge-amended soil may not be available for crop uptake.

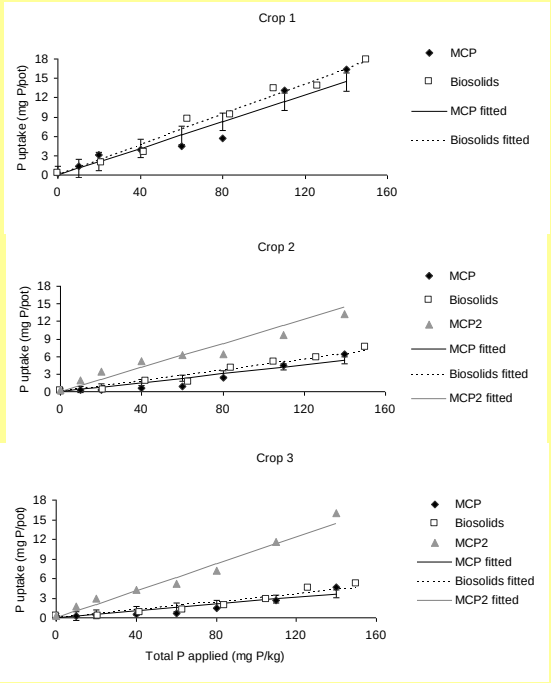

Figure 1 Relationship between P uptake in shoot DM of wheat for P applied as MCP, biosolids and freshly applied MCP (MCP2) at 33 DAS for three consecutive crops

Fitted lines plotted using Microsoft Excel Solver from equation (1) and coefficients given in Table 3.5. Vertical bars denote LSD (P = 0.05) for data from means of three treatment replicates for MCP and biosolids treatments. LSD for fresh MCP crop 2=1.14, fresh MCP crop 3=1.81.

Conclusions

Overall biosolids were a useful source of P for plant growth. The phytoavailability of P in the biosolids products examined was dependent on several factors, such as the biosolids treatment, soil conditions (soil P status, soil moisture) and management (placement of biosolids). Lower phytoavailability was measured in alum sludge and poses additional challenges for land application.

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