

Nitrogen response of spring and winter wheat to biosolids compared to chemical fertiliser

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Introduction Irish sewage sludge production was over 30,000 t/year in the 1990s (EPA, Ireland, 2003). Application to agricultural land is a management option for this organic material as it results in the recycling of the nutrients they contain for crop production. The EU Directive (91/271/EEC) encourages the recycling of sewage sludge as biosolids to agriculture. However, up to 1999, only about 5 % of biosolids produced was applied to agricultural land. In this study, several biosolids and a chemical fertiliser were used to assess N availability for spring and winter wheat (*Triticum aestivum*) production in a pot experiment.

Materials and methods The experiments were carried out in a solarium from May to July 2001 for spring wheat, and from December 2001 to June 2002 for winter wheat. Three types of biosolids [anaerobic biosolid (AB), dried biosolid (DB) and lime biosolid (LB)], cattle slurry (CS) and chemical fertiliser (CF) were used as N sources. The materials were applied at rates of 90 and 180 mg N/pot for spring wheat and 180 and 360 mg N/pot for winter wheat. There was also a control treatment with zero-N in each case. P and K were applied at sowing time to meet crop requirements. In each pot (area 227 cm²) 2 kg of loam shale soil (87.5 % dry matter, pH 5.9) was placed over 1 kg of sand. The wheat was sown at a rate of 1.0 g/pot and harvested at the vegetative stage. The dry weight and N content were measured.

Results and discussion The N uptake (mg/pot) for all the treatments and the equations for the linear responses to CF in spring and winter wheat are shown in Figure 1. The N uptakes from AB, LB and CS (90 and 180 mg N/pot) in spring wheat were not much different from each other, however, CF was the highest and DB was significantly the lowest. For example, in the 180 mg N/pot treatment were CF 198.3 (a), AB 115.4 (b), LB 102.0 (b,c), CS 88.1 (c)

and DB 31.6 (d) mg/pot (means with a letter in common are not significantly different). In contrast, there were some different trends between the treatments in N uptake for winter wheat (180 and 360 mg N/pot); the CF treatment gave a lower slope than in spring wheat, in addition LB and DB gave a higher yield than CF. For example, in the 180 mg N/pot treatment N uptakes were LB 49.3 (a), DB 33.2 (b), CF 24.8 (c), AB 22.2 (c) and CS 17.2 (c) mg/pot. From the above, the efficiency (E) of N uptake in the biosolids relative to CF (Table 1) was calculated by the following formula (Pommel, 1995): $E (\%) = (A_1/A_2) \times 100$, where A_1 = slope for biosolids and A_2 = slope for CF.

The relative efficiency of each biosolid in spring wheat was 48, 39 and 30 % for AB, LB and CS, respectively, while DB was negative. In contrast, LB and DB showed higher responses (over 100 %) in winter wheat. This may indicate that calcium or organic bound N in LB and DB was converted to more available forms before or during winter wheat growth.

Conclusions Biosolids can be used to replace part of the N requirements of wheat. The relative efficiency of LB and DB for winter wheat is higher than CF, however, biosolid N for spring wheat is generally lower than in CF. Biosolids cannot be relied upon to supply sufficient N to produce full crops of spring wheat unless applied the previous year. Therefore, supplementary fertiliser N should be used with this crop.

References

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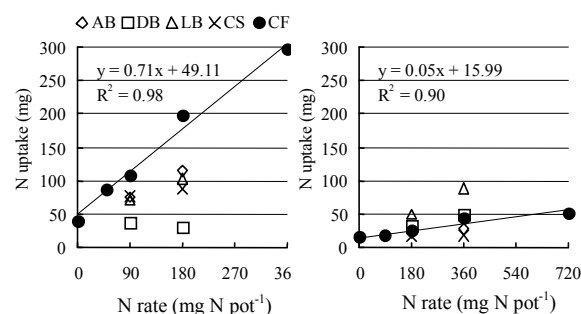


Figure 1 N uptake (mg per pot) for spring (left) and winter wheat (right)

Table 1 Relative efficiency (%) of each biosolid as an N source compared to chemical fertiliser for N uptake

	AB	DB	LB	CS	CF
Spring wheat	48	<0	39	30	100
Winter wheat	45	116	249	15	100