Nitrogen Response of Spring and Winter Wheat to Biosolids Compared to Chemical Fertiliser

W. Kato
Teagasc, Ireland

O. T. Carton
Teagasc, Ireland

D. McGrath
Teagasc, Ireland

H. Tunney
Teagasc, Ireland

W. E. Murphy
Teagasc, Ireland

See next page for additional authors

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W. Kato, O. T. Carton, D. McGrath, H. Tunney, W. E. Murphy, and P. O'Toole

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W. Kato[1,2], O.T. Carton[1], D. McGrath[1], H. Tunney[1], W.E. Murphy[1] and P. O'Toole[2]
[1]*Teagasc, Johnstown Castle Research Centre, Wexford, Ireland, Email: kato@vmas.kitasato-u.ac.jp,* [2]*University College Dublin, Dublin 4, Ireland,*

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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 cm^2) 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 (%) = $(A_1/A_2)\times100$, where A_1 = slope for biosolids and A_2 = slope for CF.

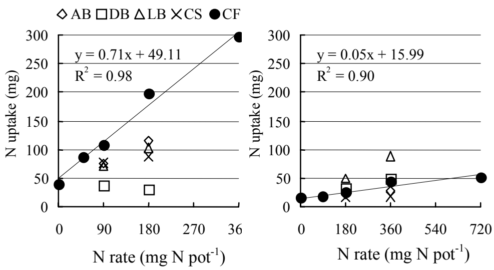

Figure 1 N uptake (mg per pot) for spring (left) and winter wheat (right)

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.

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

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

EPA, Ireland (2003) Urban Waste Water Discharges in Ireland, A Report for the Years 2000/2001. Environmental Protection Agency, Ireland. 99pp.

Pommel, B. (1995) Value of a heat-treated sludge in the phosphorus fertilization. *European Journal of Agronomy* 4, 395-400.