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The effects of 'Biosolids' on soil biota – a laboratory study

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Introduction Current EU directives (ED 86/278/EEC) promote the recycling of municipal sludge in agriculture and to set standards to protect the environment and food quality. Treated sludge is termed 'biosolids' of which an estimated 150,000 tonnes will be produced annually in Ireland by 2020. The only means of disposing of this material, in compliance with current regulations, is by land spreading. Biosolids may improve soil fertility and structure and benefit crop yields, however, their impact on agricultural ecosystems are unknown. The objective of this study was to investigate the effects of biosolids from various sources in Ireland and applied at different rates on sensitive indicator invertebrate species under laboratory conditions.

Materials and methods The species investigated were the earthworm *Eisenia fetida* and the springtail *Folsomia candida*. Worms and springtails of similar age and development stage were obtained following the collection of cocoons and eggs, respectively, from populations reared in a controlled environment cabinet at 20 ^{o}C and 12 h : 12 h D : N. Artificial soil, composed of kaolinite 20%, moss 10% and quartz sand 70%, was used for worm trials in boxes 10 x 10 x 10 cm and containers of 5.5 cm diam. and 6.5 cm in height were used for springtails. Worms were reared on reconstituted cow manure and springtails reared on yeast. Biosolids (≈ 90 – 96 % DM) were obtained from the five plants throughout the country. The rate of applied biosolids were equivalent to 2, 5, 10 and 20 t/ha (recommended rate is 2 t/ha) were compared with untreated controls. Replication was 6-fold. Ten worms and ten springtails were used per treatment. Mortality and biomass of the adult worms were recorded after 28 days and the number of juvenile earthworms after 56 days. Mortality/reproduction of springtails were recorded after 28 days. The data were analysed using the general linear model procedures (SAS 9.1, 2003).

Results Applying Biosolids at the 2 t/ha rate had no affect on the mortality of adult worms. While the 5 t/ha rate resulted in the death of a small number of worms the difference with that for the 2 t/ha was not significant. Increasing the rate of application of any of the five Biosolids from 5 t/ha to 10 t/ha caused a significant ($p=0.01$) reduction in worm number. There were significantly fewer worms recovered from the 20 t/ha rate than that for 10 t/ha. Juvenile worms were significantly fewer than controls for a one Biosolid at the 2 t/ha rate and for three Biosolids at 5 t/ha. No juvenile worms were recorded at the 10 t/ha and 20 t/ha rates, respectively for two and four of the Biosolids investigated. Comparisons of Biosolids from different sources based on the number of juvenile worms produced showed differences were significant.

In the case of adult springtails, significantly fewer were recorded for the 2 t/ha rate when compared with that for untreated controls. The difference in adult numbers between the 2 t/ha and 5 t/ha rates was not significant. Neither was the difference between the 5 t/ha and 10 t/ha rates. However, the 20 t/ha rate had significantly fewer adults than that for the 10 t/ha. Each of the four rates of Biosolids had significantly fewer juveniles when compared with controls. When compared with the 2 t/ha rate the 5, 10 and 20 t/ha rates had significantly fewer juveniles. Juvenile springtail numbers recorded for the 5 t/ha rate did not differ significantly with that for 10 t/ha but were significantly greater than that for the 20 t/ha rate. The number of juveniles recorded for the 10 and 20 t/ha rates were low and were not significantly different. Comparing the number of juveniles recorded for the different Biosolids showed significant differences *i.e.* a source effect.

Conclusions Applying Biosolids at 2 or 5 t/ha had no effect on the mortality of adult worms. Significant worm mortality occurred at the 10 and 20 t/ha rates. The production of juvenile worms was reduced at the 2 t/ha rate while above this rate relatively few juveniles were produced. The 2 t/ha rate caused mortality of adult springtails and reduced production of juveniles. Biosolids from different locations differed in their effects on worms and springtails. Overall, the laboratory study showed that while the application of Biosolids at the normal rate of 2 t/ha does not affect adult worms it reduces the production of juveniles and negatively impacts on both adult and juvenile springtails.

References

EC (European Commission), 1986. Council Directive on the protection of environment, and in particular of the soil, when sewage sludge is used in agriculture 86/278/EEC of 12 June 1986.
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