

Effect of C/N ratio and bedding type on nitrogen mineralization from cattle slurry

Andersson, K.^{a*}, Dahlin, A.S.^a, Sørensen, P.^b & Delin, S.^a

Swedish University of Agricultural Sciences, Sweden ^a; Aarhus University, Denmark ^b; *Corresponding author, email: karin.i.andersson@slu.se

Introduction

Previous studies have suggested that nitrogen fertilization effect of animal slurries is dependent on C/N-ratio. However, the bedding material characteristics may affect this relationship. The objective with this study was to compare net N mineralization at different C/N-ratios depending on source and particle size of bedding materials in slurry.

Methodology

An incubation study was conducted. The liquid fraction (LF) from mechanical solid-liquid separation of cattle slurry was mixed with chopped straw, ground straw, sawdust or solid fraction (SF) of slurry to create manures with different C/N-ratios and bedding materials. For mixtures with SF and chopped straw, mixture C/N ratios of 10, 12 and 14 were studied, and for ground straw and sawdust C/N ratio 12 only. The materials were added to a sandy loam soil at a rate of 102 mg total N/kg dry soil in all treatments, while the amount of total C varied with C/N ratio. The samples were incubated in a climate chamber at 15 C°, and at day 0, 3, 7, 14 and 28, three replicates from each treatment were destructively sampled and analysed for mineral N content. In a parallel incubation including the same treatments, C mineralisation was studied as an indicator of C availability for the different bedding materials. For this, three additional replicates of soil samples with manure added were placed in glass jars together with beakers containing KOH solution absorbing the CO₂ evolved. By changing the CO₂ traps and measuring the electrical conductivity in the KOH solution at days 2, 5, 10, 15, 21 and 28, cumulative CO₂ evolution could be calculated. The net release of mineral N and C from manures was estimated by subtracting the release from a control soil.

Results and discussion

The differences in net N release between C/N ratios (only chopped straw and SF included) were significant ($p < 0.001$), and the amount of N mineralised (as percent of total N added) at the end of the experiment (day 28) was on average 36%, 30% and 26% for C/N ratio 10, 12 and 14, respectively. There was a negative linear correlation between C/N ratio and mineral N content, at day 14 and 28. At day 14 there was a steeper relation for SF than for chopped straw, while at day 28 the relationship did not differ between bedding materials. At C/N ratio 12, slurry with sawdust had significantly higher ($p = 0.001$) soil mineral N release at day 28 with 39% of added total N, compared with 28-30% for the other bedding materials. Cumulative CO₂ emission (as percent of total C added) was negatively correlated to C/N ratio at all sampling dates except day 28, where the difference between C/N ratio 10 and 12 was non-significant. At C/N ratio 12, cumulative CO₂ emission at day 28 was highest for SF and ground straw (46% of added total C), followed by chopped straw (38%) and lowest for sawdust (33%) ($p < 0.001$).

For sawdust, showing the lowest cumulative CO₂ emission and the highest mineral N release at the end of the experiment, the results indicate that a lower C availability caused less immobilisation of N. The higher CO₂ emission from ground straw compared to chopped straw indicates an effect of bedding material particle size on C availability, while for N release there were no difference.

Conclusion

The net release of mineral N from total manure N showed a negative linear relationship with manure C/N ratio after four weeks decomposition in soil, while no difference was seen between the bedding materials, except the sawdust treatment that had a higher mineral N release. The higher N release from slurry containing sawdust was related to a lower C mineralisation rate in soil. For straw, the particle size had an effect on CO₂ emission, but not on N release.

Acknowledgements

Thanks to Stina Larsson for practical assistance during the incubations and to Region Västra Götaland for funding.