

Cattle slurry to grassland in northern Sweden – effects of application time

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Abstract Field studies of cattle slurry application in autumn and in spring were conducted in Umeå, Sweden. Ammonia volatilization varied between 22 and 92 % of applied ammonium-N, and was enhanced by dry and windy weather. In a ¹⁵N-labelling study in micro-plots, plant nitrogen recovered in roots, stubble and above ground biomass was 28 – 41% of applied ¹⁵N ammonium 1 to 2.5 months after application. More ¹⁵N was recovered in the first and second harvest after spring application than after autumn application since in autumn slurry nitrogen was allocated to the roots and only partly used for aboveground growth in spring. Total nitrogen in harvested biomass, however was not significantly different between the slurry treatments.

Introduction

In northern Sweden, autumn spreading of slurry to grassland is a common practice in order to prevent harmful soil compaction from heavy tankers and slurry contamination of the silage with spring application. To assess the environmental and agronomic consequences of autumn spreading on grass, we performed a two year study of cattle slurry application using unfertilized crop as control.

Material and Methods

Production experiment

The experiments were located in Umeå, Sweden (64° north) on grass leys with timothy and meadow fescue. At five occasions, two in August, two in September and one in May, the rate of 25 t ha⁻¹ of cattle slurry was spread to field plots (four replicate 4 m x 10 m plots) to mimic surface band spreading. We quantified ammonia (NH₃) volatilization the days after slurry application, inorganic nitrogen (N) in soil in autumn and spring and plant growth and nutrient uptake during the growing season after slurry spreading.

Microplot experiment with 15N-labelling

Plant N uptake was measured using ¹⁵N-labelled slurry in micro-plots 0.35 m x 0.35 m with harvesting of aboveground biomass, stubble and roots. Slurry application was made 0-3 days after slurry application in the production experiment. The slurry was homogenised by sieving (4 mm mesh). The content of total ammoniacal N (TAN) was estimated with an Agros Nitrogen-meter after sieving and the slurry was labelled with 98% ¹⁵N urea corresponding to 10% of the TAN. The slurry was incubated for 3 days in closed vessels in a 35°C shaking water bath to let the urea hydrolyse before spreading in the micro-plots in a band at the middle of the plot. In half of the plots regrowth or stubble and roots from 0 - 0.15 m depth were harvested 1 to 2.5 months after slurry application (late autumn or after first harvest). The remaining plots were destructively harvested after the second harvest in early August the growing season after slurry application.

Results

Ammonia volatilization varied between 22 and 92 % of applied TAN, and was enhanced by dry and windy weather. The N and the potassium (K) content of the harvests were enhanced by slurry application. The soil sampling showed only minor increases in inorganic N down to 90 cm depth, compared to the control.

For both autumn and spring application, 28 – 41% of applied ¹⁵N ammonium was recovered in above- and belowground plant biomass 1 to 2.5 months after application. More ¹⁵N was recovered in the first and second harvest after spring application than after autumn application but the total amount of N in

the harvests was not different among the application times and it was always enhanced compared to the unfertilized control ($P < 0.05$). More of the slurry N was allocated to belowground biomass after autumn application than after spring application. The results of this study will be published elsewhere in more detail [1].

Conclusion and perspectives

The apparent nitrogen recovery (ANR) of surface band spreading of slurry in autumn was not different from spring application, and the ammonia losses were more dependent on the weather after each specific spreading occasion than on the season. Thus in a cold temperate climate, autumn application of cattle slurry to grasslands can be an acceptable practice provided it is done in August or September.

References

[1] Palmborg C, Rodhe L, Ericson, L 2013. Cattle slurry application to northern grasslands in early autumn – dry matter yield, plant nutrient uptake, ammonia emissions and soil mineral nitrogen. Grass and Forage Science, submitted