Reduction of ammonia losses after spreading of cattle slurry to grassland by acidification and injection

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Ammonia (NH_3) losses are in main focus to be lowered as it is an indirect greenhous gas. Especially in grassland the application of cattle slurry leads to high losses, as it is surface applied and the total application rate is splitted into several doses to be applied in spring and after harvest of grass. Particularly warm weather after slurry application will increase ammonia losses. Several application techniques to lower ammonia losses are known. As incorporation can`t be used on grassland, injection and the new system of field based acidification seem to be potentially useful as NH_3 abatement technique in slurry application. To test the potential of these methods compared to the best practice method band spreading, a multiplot field trial was established at two perennial grassland sites (site 1: German coastal marsh; site 2: Danish sandy soil). Both sites were close to the German-Danish border with a distance to each other of approximately 50 km. The field trial was established in a fully randomized block design, fourfold replicated, while single plots had a distance of 9 m to neighboring plots, to reduce ammonia drift. It was conducted in 2012 and 2013, and 5 different application methods were tested: 1. Band spreading, 2. Injection A (17.5cm slot distance), 3. Injection B (35cm slot distance), 4. Acidification A (pH 6.5), 5. Acidification B (pH 6.0). The band spreading as well as the acidification treatments were applied with a typical trail hose system (3m width for trial use) and injection was done with an open slot double disc system. Acidification was not done by an original SyreN sytem as it was to large for trial purposes. To ensure similar conditions compared to the commercial technique, directly before application in the field, the slurry was acidified and mixed with concentrated sulfuric acid (96% H_2SO_4). At site 1 in both years 4 and at site 2 in 2012 2 and in 2013 4 fertilization and measurement campaigns were conducted (in total 14). The measurements of ammonia loss were done with a combined method of calibrated passive flux samplers (Gericke et al. 2011, Ni et al. 2014).
In table 1 the mean ammonia losses of all application dates for each method are shown expressed as relative ammonia loss (% of applied NH_4^+-N). As expected, bandspreading showed highest losses of 14.0% while all abatement techniques resulted in lower losses. Highest efficiency in lowering ammonia losses was achieved with 68.9% by acidification to pH 6.0 while an average of 4.4 l acid per ton of slurry was consumed. Acidification to pH 6.5 with an average acid use of 2.7 l per ton of slurry resulted in a reduction of 42.2% compared to band spreading. The more effective injection method was the treatment with 35 cm disc distance that showed reduction of 60.6%. Injection with 17.5 cm disc distance resulted in a emission reduction of 31.4% compared to band spreading.

Tabelle 1: Mean relative ammonia losses in % of applied NH_4^+-N. Numbers in brackets show standard deviation. Different letters indicate significant differences ($p < 0.05$). Unpublished data.

	Band spreading	**Injection 17.5**	**Injection 35**	**Acid pH 6.5**	**Acid pH 6.0**
Mean NH_3-loss rel. [%]	14.0 (1.4) a	9.6 (1.1) b	5.5 (0.6) cd	8.1 (0.8) bc	4.4 (0.9) d
Reduction vs. Bandspreading [%]		31.4	60.6	42.2	68.9