FARMING PRACTICE
SOIL AMENDMENT WITH BIOCHAR

IMPACT: GRASSLAND PRODUCTION

Reference 30

Cai, YJ; Akiyama, H 2017 Effects of inhibitors and biochar on nitrous oxide emissions, nitrate leaching, and plant nitrogen uptake from urine patches of grazing animals on grasslands: A meta-analysis SOIL SCIENCE AND PLANT NUTRITION, 63(4), 405-414. 10.1080/00380768.2017.1367627

Background and objective

Excreta (urine and dung) patches on grazed grasslands are significant sources of nitrogen (N) trace gas emissions and leaching. Nitrification inhibitors (NIs), urease inhibitors (UIs) and biochar have been tested to reduce N losses and increase N utilization in various agro-ecosystems. Although the effectiveness of NIs, UIs or biochar on N losses or N utilization for chemical N fertilizers and manures have been evaluated in previous studies, there has been no comprehensive assessment on their effectiveness for excreta patches of grazing animals on grassland. The authors conducted a comprehensive meta-analysis of their effects on N_2O emissions, NO_3–leaching, plant N uptake, and plant yields to better understand the effects of inhibitors and biochar on the major N dynamics in excreta patches. The following two main objectives were addressed: 1) evaluating the effects of inhibitors and biochar on N losses or uptake; 2) investigating the main factors that affect the efficacy of inhibitors and biochar in grazed grassland ecosystems.

Search strategy and selection criteria

A literature survey of peer-reviewed publications was performed using Web of Science and Google Scholar, with the keywords of 'N_2O', 'NO_3–leaching', 'N uptake' or 'plant yield'and 'urine'or 'dung'and 'soil'or 'grassland'in combination with 'NI', 'UI', or 'biochar', before February 2016. The inhibitor types considered for the analysis were DCD (a NI), pyrazole derivatives (PD, a NI), and N-(n-butyl) thiophosphoric triamide (NBPT, a UI). Only direct measurements were included and no data were obtained from modeling studies. Studies performed under laboratory, greenhouse, and field conditions were all included. Only studies with a measurement period that lasted longer than 30 days were considered.

Data and analysis

The effect sizes were calculated for each grouping using a categorical random effects model. The mean effect size for each category and the bias-corrected 95% confidential intervals (CIs) were generated by a bootstrapping procedure (9999 iterations). The meta-analysis was conducted using META-WIN version 2.0. Publication bias was analyzed by rank correlation test using META-WIN version 2.0.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
44	Grasslands	1) Dicyandiamide in liquid form (DCD(L)); 2) dicyandiamide coated with zeolite (DCD(Z)); 3) pyrazole derivatives in liquid form (PD); 4) N-(n-butyl) thiophosphoric triamide in liquid form (NBPT); 5) NBPT and DCD in liquid form (NBPT + DCD(L)); 6) biomass-derived charcoal (biochar)	1) No inhibitor; 2) no biochar	Metric: Plant yield; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	75

Results

- Biochar addition caused a significant decline in plant yield (−3%, −5% to −2%).
- NULL
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Biochar has a negative effect on yield.