# FARMING PRACTICE
# SOIL AMENDMENT WITH BIOCHAR

## IMPACT: AIR POLLUTANTS EMISSIONS

### Reference 20

Sha, ZP; Li, QQ; Lv, TT; Misselbrook, T; Liu, XJ 2019 Response of ammonia volatilization to biochar addition: A meta-analysis Sci Total Environ. 655:1387–96. 10.1016/j.scitotenv.2018.11.316

### Background and objective

The effects of biochar addition on ammonia volatilization (AV) appeared contradictory from the many reported studies and the main influencing factors remain unclear. Investigate the effects of biochar on AV and combined this with boosted regression tree model analysis to further interpret the contribution of biochar characteristics, soil properties and experimental conditions.

### Search strategy and selection criteria

Published literature from 1970 to April 2017 were searched from several databases (Web of Science (ISI), Google Scholar, China National Knowledge Infrastructure (CNKI)) by using the key words: 'ammonia volatilization', 'ammonia emission', 'biochar' and 'black carbon'. 1) Experimental details such as location, year and treatment to be reported to enable removal of duplicates. 2) Paired design (including a control and a treatment with biochar, the control having the same experimental conditions without a biochar treatment). 3) Original data regarding cumulative AV or loss proportion to be presented. 4) Sample size, AV mean values and standard deviations of the means to be provided.

### Data and analysis

A categorical random-effects model was adopted to calculate the effect size of each group, where the effect size was weighted using the inverse of the pooled variance. Calculations of the effect sizes and the 95% confidence intervals (CIs) were performed in MetaWin statistics software (Version 2.1) using the bootstrapping procedure (4999 iterations). The heterogeneity between groups (QB) was tested and the p-value of each categorical random-effects model was reported under the x axis of forest plot. Boosted regression tree (BRT) analysis was used, which combined classification and regression modelling with a boosting approach to improve the accuracy and stability of the model by fitting multiple models and combining these models to give improved predictive performance

| Number of papers | Population | Intervention | Comparator | Outcome | Quality score |
|---|---|---|---|---|---|
| 41 | Not specified | Soil amendment with biochar | No amendment | Metric: Ammonia emission; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control | 0.875 |

### Results

- Overall, biochar application had no impact on ammonia volatilization (RR = 0.92%, CI: −12.45–13.38%).
- Wood-based biochar application significantly reduced AV (RR = −34.6%, CI: −51.1 to −15.9%). The AV was slightly increased with herbaceous-based biochar (RR = 11.4%, CI: −3.7–29.7%). Other feedstocks had no significant impact on AV.
- Biochar applied to acidic soils could enhance AV (38.4%). Increases in AV were also caused by amendment with high pH biochar (30.8%), or combing biochar with ammonium-based fertilizers (67.9%). Reductions in AV were observed when biochar was applied to fine soils (high SOC (−42.8%) and clay content (−58.4%)) at appropriate rates (5–15 t ha−1; −33.8%), was combined with urea or organic fertilizers (−18.6% and −28.7%), was used with appropriate N-fertilizer rates (<200 kg N ha−1; −33.5%), and was applied as acidified biochar (−42.2%).

### Factors influencing effect sizes

- Biochar pH : The application of acidic biochar (pH ≤ 4) significantly decreased AV (RR = −42.2%, CI: −58.1 to −21.5%), while introducing high pH biochar (>9) increased AV by 30.8% (CI: 9.9–59.4%).
- Biochar BET surface area : Increasing biochar surface area initially reduced AV, but for biochar with surface area values >80 m2 g−1, application tended to increase AV
- Biochar carbon content : High biochar carbon content (>65%) reduced AV, while biochar of carbon content around 50 to 60% were associated with an increase in AV.
- Soil pH : Ammonia volatilization increased after biochar application to acidic soils (pH ≤ 6) (RR = 38.38%, CI: 11.9–75.1%).
- Soil nitrogen : Ammonia volatilisation from soil initially increased with increasing STN following biochar addition, but for STN values above 2 (g/kg) AV tended to remain steady.

### Conclusion

Biochar addition did not impact on ammonia volatilization, but this varied under different soil, biochar and experimental conditions.