FARMING PRACTICE
IL AMENDMENT WITH LIME AND GYPSUM

IMPACT: HEAVY METALS POLLUTION

Reference 1

Kong L, Guo Z, Peng C, Xiao X, He Y 2021 Factors influencing the effectiveness of liming on cadmium reduction in rice: A meta-analysis and decision tree analysis Sci Total Environ. 779:146477 10.1016/j.scitotenv.2021.146477

Background and objective

Lime is widely applied as a soil amendment to reduce the grain cadmium (Cd) content in rice production. However, the effectiveness of liming on grain Cd reduction is inconsistent and often cannot meet the safety requirements established for rice production. 1) study the effects of lime application on Cd reduction in rice grains among the different studies; 2) analyze the factors influencing the effectiveness of liming, such as experiment type (field or pot), soil environment, type and dosage of lime, and rice cultivars; and 3) identify the soil environmental factors that affected the Cd content in rice grains.

Search strategy and selection criteria

To analyze the effectiveness of liming on rice Cd reduction, we collected relevant peer-review articles from literature databases, including the Web of knowledge (http://www.webofknowledge.com/), Elsevier (http://www.sciencedirect.com/), and China national knowledge infrastructure (https://www.cnki.net/). The search was conducted for the period between 2009 and 2019 using the keywords of "lime", "soil contamination", "cadmium", " amendment", and "rice". 1) the control and the treatments should be subject to the same management conditions, and lime was adopted alone as one type of soil amendment, and (2) all treatments had at least three replicates and the Cd content in rice grains should be presented as a mean and standard deviation (SD).

Data and analysis

The meta-analysis, with a random-effects model, took into account not only the variability within studies, but also the variability between studies. The Person's correlation analysis with a two-tailed test was conducted to study the relationship between reduction rate and contents of Cd in rice grains and soil environmental factors by SPSS 22.0

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
39	Rice cultivation	Liming treatment, including $CaCO_3$, $Ca(OH)_2$, and CaO	No-liming control under identical experimental conditions	Metric: Cd concentration in grains; Soil available Cd; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.9375

Results

- The average grain Cd reduction rate after liming was −44%, with a 95% CI of −44% to −48%.
- The average reduction rates of grain Cd and soil available Cd content in the pot experiments were −48% and −62%, respectively, while in the field trials the corresponding values were −42% and −38%, respectively.

Factors influencing effect sizes

- Scale of experiment : Liming in pot experiments resulted in a slightly better reduction than was achieved in the field experiments, but the difference was not significant. The reduction rates of soil available Cd between the pot and field experiments were significantly different ($p < 0.01$).
- Liming rate : The average grain Cd reduction rates under lime dosages of >4500 kg/ha, 1500 to 4500 kg/ha, and <1500 kg/ha were −63%, −40%, and −37%, respectively. This suggests that liming at levels >4500 kg/ha would significantly elevate the grain Cd reduction rate compared to smaller dosages. Lime dosages between 1500 and 4500 kg/ha and <1500 kg/ha had similar grain Cd reduction rates. However, differences in the soil available Cd content at lime dosages between 1500 and 4500 kg/ha and <1500 kg/ha were significant ($p < 0.01$), suggesting that lime application had a larger impact on the soil available Cd content than on the grain Cd content.
- Type of lime : The application of $CaCO_3$ had significantly better effects on rice grain Cd reduction than applications of CaO and $Ca(OH)_2$.
- Soil Cd concentration : Applying lime to soils with total Cd contents >1 or <1 mg/kg decreased the average Cd content in rice grains by −40% and −46%, respectively. The average grain Cd reduction rates with liming were −55%, −45%, and −33% when the soil available Cd content was <0.2, 0.2 to 1, and >1 mg/kg, respectively. These results suggested that the higher the total or available Cd contents in the initial soils, the less effective liming was for reducing Cd uptake in rice.
- Soil texture : The average grain Cd reduction rates in clay, loam, and sandy soils were −48%, −59, and −35%, respectively.

Conclusion

Cd reduction rates achieved by liming varied considerably between studies, with a significant average of −44%.