FARMING PRACTICE
SOIL AMENDMENT WITH LIME AND GYPSUM

IMPACT: CROP YIELD

Reference 4

Pias, OHD; Tiecher, T; Cherubin, MR; Silva, AGB; Bayer, C 2020 Does gypsum increase crop grain yield on no-tilled acid soils? A meta-analysis Agronomy Journal 112, 675–692. 10.1002/agj2.20125

Background and objective

The response of crops to gypsum is contradictory and ranges from a substantial increase to a slight decrease in grain yield. 1)What is the subsoil acidity threshold for recommending gypsum application to no-tilled (NT) soils? 2) What are the factors most strongly influencing the response of grain yield to gypsum in NT soils? and 3) What is the probability of a positive response and the associated mean increase in grain yield in NT soils?

Search strategy and selection criteria

A literature search for studies on the response of grain crops to gypsum applied to NT soils was conducted on the Scielo, Scopus, Web of Science, and Google Scholar databases from September 2017 to February 2019. The search terms used, both in English and in Portuguese, were as follows: no-till/no-tillage, gypsum, phosphogypsum, and crop yields. The search was extended to relevant studies found on the reference lists of the initial sources. Exclusion when: (i) plants grown in a greenhouse or on tilled, harrowed soil; (ii) absence of a control treatment (i.e., no gypsum application); (iii) fewer than three replicates and/or absence of causation; (iv) no initial assessment (baseline) of subsoil acidity; and (v) crops with data from fewer than five harvests.

Data and analysis

The grain yield data for the target crops as obtained with (treatments) and without gypsum (control) were used to calculate the response (treatment/control) ratio, which was used as the effect size in the meta-analysis. The procedure involved calculating the natural logarithm of the response ratio for grain yield at each gypsum rate used. After confirming that the vast majority of primary studies included in the meta-analysis exhibited no data dispersion in terms of variance, SD, and SEM, observations were weighted according to number of replicates. Those observations exceeding five times the SD of the median in each data subgroup were assumed to be outliers and were excluded. The 95% CIs for the weighted mean of effect size in each subgroup were established by using the Bootstrapping procedure with 4999 repetitions. Gypsum application was assumed to have a significant effect when the CIs did not overlap zero. Heterogeneity among groups was assessed by using randomization procedures comprising 4999 repetitions and assuming differences to be significant at $p \leq .05$. Statistical calculations were performed with the software Statkey v. 2.0.1.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
43	Arable crops	Gypsum application	No gypsum	Metric: Crop yield; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.8125

Results

- Cereals (maize, wheat, white oat, barley, and rice) have a high probability (77–97%) of t heir grain yield being increased by gypsum application to soils, with Al saturation exceeding 5% in t he 0.20-to 0.40-m layer.
- The average increase in grain yield was 14 and 7% in crops growing in the presence and absence of water deficiency, respectively
- A positive response of soybean to gypsum was observed in water-deficient soils with Al saturation excee ding 10%. Under these conditions, the probability of a positive response of soybean was 88%, and the average yield increase was 12%.

Factors influencing effect sizes

- Al saturation : Higher yield gain in case of high Al saturation
- Water deficiency : High yield gain in case of water deficiency
- Crop species : Higher yield gain for cereals than for soybean

Conclusion

Gypsum application decreases Al toxicity to plants and increases crop grain yields as a result in no-tillage soils with high Al saturation.