



Does animal manure application improve soil aggregation? Insights from nine long-term fertilization experiments

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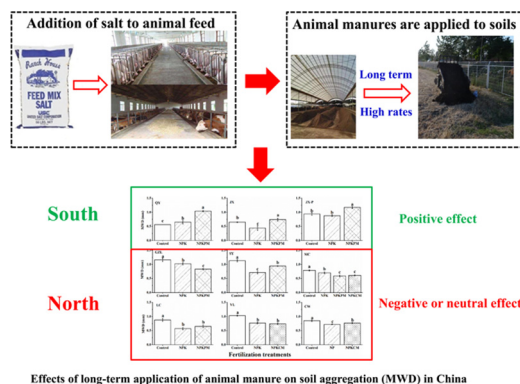
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HIGHLIGHTS

- Animal manure improved soil aggregation in southern China but not in northern China.
- Animal manure degrades soil structure due to Na^+ accumulation in dry regions.
- The Na^+ accumulation in soils was negatively related to mean annual precipitation.

GRAPHICAL ABSTRACT



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ABSTRACT

Manure application is widely recognized as a method of improving soil structure and soil fertility due to additional organic matter and nutrient inputs. However, the salinity of animal manure may have a detrimental effect on soil aggregation. The objective of this study was to determine the effects of long-term animal manure application on soil aggregation, binding agents (soil organic carbon, SOC and glomalin-related soil protein, GRSP), and dispersing agents (e.g., Na^+) and their relationships based on nine long-term fertilization experiments (12 to 39 yr) across China. The two red soil experiments (Qiyang, QY and Jinxian, JX) and one paddy soil experiment in Jinxian (JX-P) were conducted in southern China (precipitation above 1200 mm yr^{-1}), whereas the other six experiments were established in semi-humid or arid regions in China with precipitation in the range of $500\text{--}900 \text{ mm yr}^{-1}$. Each experiment included three treatments as follows: no fertilization (Control), inorganic fertilizer (NP or NPK), and a combination of inorganic fertilizer and animal manure (NPM or NPKM). Long-term animal manure application not only significantly increased the biological binding agents (i.e., SOC and GRSP) in the nine experiments but also considerably increased the dispersing agents (i.e., exchangeable Na^+) ($P < 0.05$), except for the paddy soil experiment. Consequently, soil aggregate stability increased after animal manure application in three experimental sites in southern China but not in the experimental sites in northern

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