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THE EFFECTS OF GYPSUM ON SOIL MICROBIAL DIVERSITY AND ACTIVITY IN ACIDIC SOIL

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Abstract
Soil microbial communities are essential for the health and fertility of soils. In acidic soils, microbial diversity and activity are often compromised due to low pH, which can affect agricultural productivity. Gypsum ($CaSO_4 \cdot 2H_2O$) is a widely used soil amendment known for its ability to improve soil structure, enhance nutrient availability, and potentially alter the microbial environment. This study investigates the impact of gypsum on microbial diversity and activity in acidic soils, highlighting its potential benefits and limitations for sustainable soil management.

Introduction
Acidic soils, characterized by a pH lower than 5.5, are prevalent in many agricultural regions around the world. These soils often suffer from low microbial activity, nutrient imbalances, and reduced plant growth. The application of soil amendments, such as gypsum, has been explored to mitigate these problems. Gypsum, a naturally occurring mineral, is known for its capacity to raise soil pH slightly, improve soil structure, and provide calcium and sulfur, essential nutrients for plants and microorganisms.

Microbial communities play a crucial role in nutrient cycling, organic matter decomposition, and overall soil health. Changes in microbial diversity and activity can significantly influence soil fertility. This paper explores how gypsum application affects soil microbial communities in acidic soils, focusing on shifts in microbial diversity, enzymatic activities, and overall microbial health.

Materials and Methods

Soil samples were collected from an acidic agricultural site with a pH of 4.8. Gypsum was applied at different concentrations (0, 2, 5, and 10 tons per hectare) to determine its effect on soil microbial properties. The experiment was conducted in a controlled environment with regular moisture levels and temperature conditions.

Microbial diversity was assessed through DNA sequencing of the 16S rRNA gene for bacteria and ITS (Internal Transcribed Spacer) sequencing for fungi.

Soil enzyme activities, including dehydrogenase, phosphatase, and β-glucosidase, were measured as indicators of microbial metabolic activity. Soil pH, electrical conductivity, and nutrient levels were monitored throughout the study.

Results

The application of gypsum led to a significant increase in soil pH, with higher concentrations of gypsum resulting in a more neutral pH.

This shift in pH was associated with increased microbial activity, particularly in terms of enzymatic processes. The activity of dehydrogenase, phosphatase, and β-glucosidase enzymes was significantly higher in gypsum-amended soils compared to control soils.

Microbial diversity also increased in soils treated with gypsum. The 16S rRNA and ITS sequencing revealed an increase in both bacterial and fungal taxa in gypsum-treated soils. Notably, the relative abundance of beneficial soil bacteria, such as *Nitrobacter* and *Bacillus*, increased with higher gypsum concentrations. Fungal diversity also expanded, with a notable increase in mycorrhizal fungi, which are essential for plant nutrient uptake.

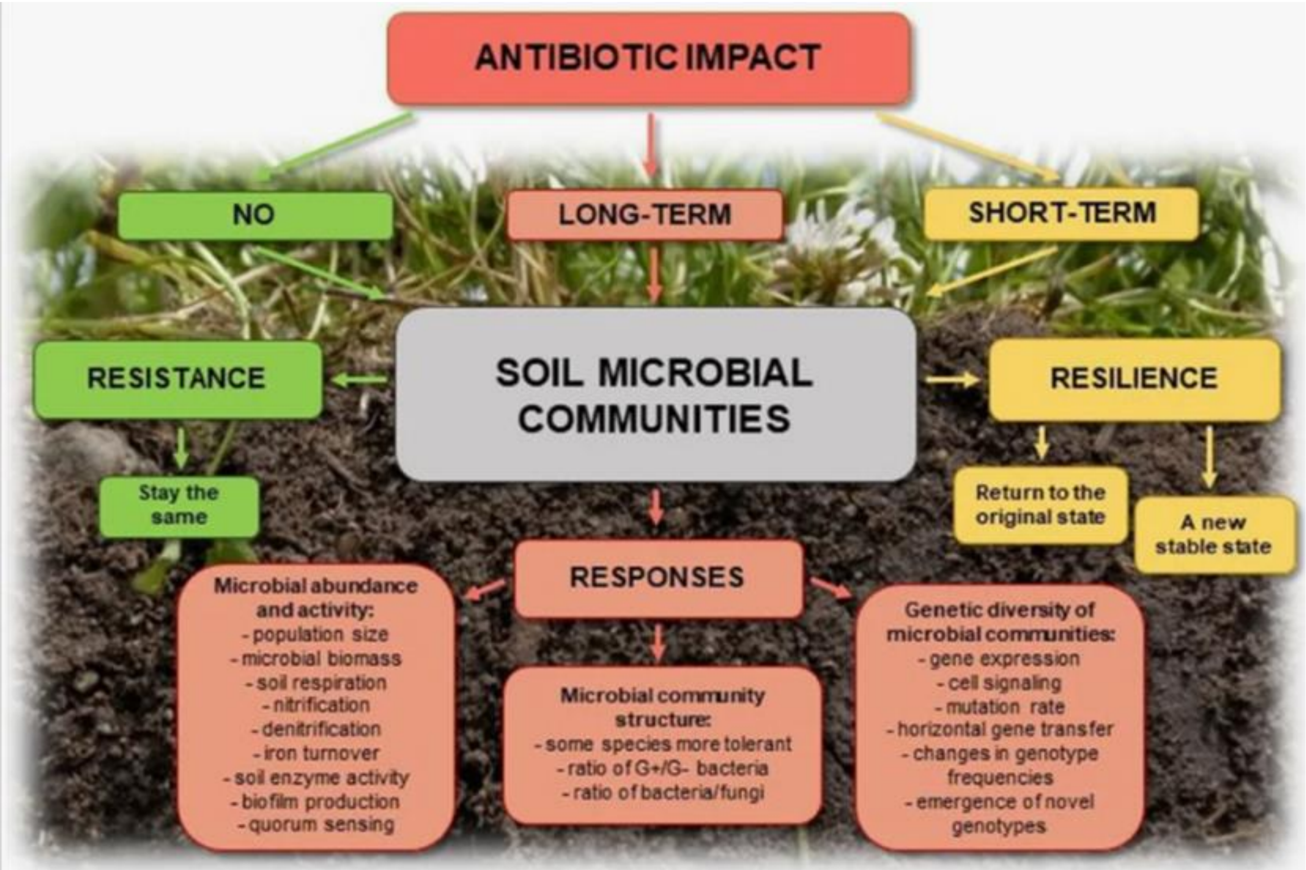

Figure 1. Sources and fate of antibiotics in the soil environment.

Discussion

Gypsum application significantly improved the microbial environment in acidic soils. The rise in pH likely created more favorable conditions for microbial growth, reducing the inhibitory effects of high acidity.

The increase in microbial diversity suggests that gypsum may enhance ecosystem stability and resilience by supporting a wider range of microorganisms. Additionally, the enhancement of soil enzymatic activity indicates a boost in microbial metabolism, which could lead to improved soil nutrient cycling.

However, the effectiveness of gypsum in improving microbial diversity and activity was concentration-dependent. At lower concentrations, the changes were less pronounced, while higher concentrations resulted in more significant improvements.

It is important to note that excessive gypsum application may lead to other soil imbalances, such as excessive calcium levels, which could negatively affect certain microbial groups.

Conclusion

Gypsum has the potential to enhance microbial diversity and activity in acidic soils, promoting healthier and more fertile soil ecosystems. By slightly raising the pH and providing essential nutrients, gypsum can support beneficial microbial communities and improve soil functionality. However, its application should be carefully managed to avoid potential adverse effects of over-application. Further studies are needed to explore long-term impacts and optimize gypsum usage for different soil types and agricultural practices.

References

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