

Exploring the Effects of Struvite Fertilizer on Wheat Growth and Greenhouse Gas Emissions



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Introduction

- ❖ Commercial fertilizers are mined from phosphorus rocks that is leading to its depletion. [1]
- ❖ These fertilizers increase soil greenhouse gas emissions such as carbon dioxide and nitrous oxide.
- ❖ Struvite is an alternative phosphorus rich fertilizer that is recovered from the urine collected in wastewater. [1]

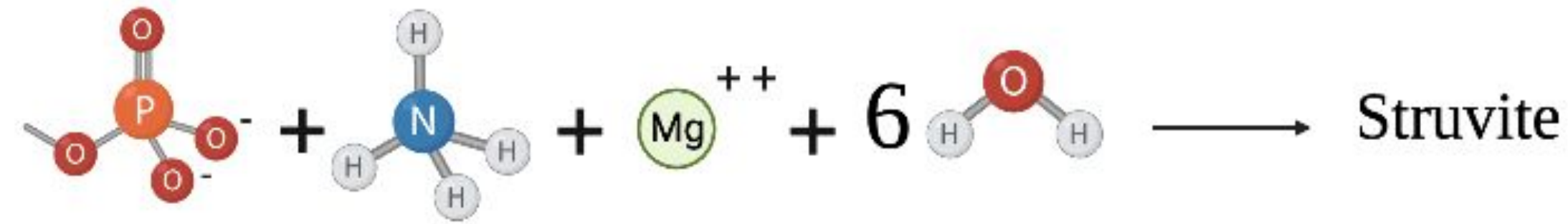


Figure 1.0 Pictorial representation of struvite formation at equimolar ratios of phosphate, ammonium and magnesium

- ❖ It is insoluble in alkaline pH levels of (8-11.5) which makes it a slow-release fertilizer that allows sustained nutrient dissolution. [1]

Experimental Results

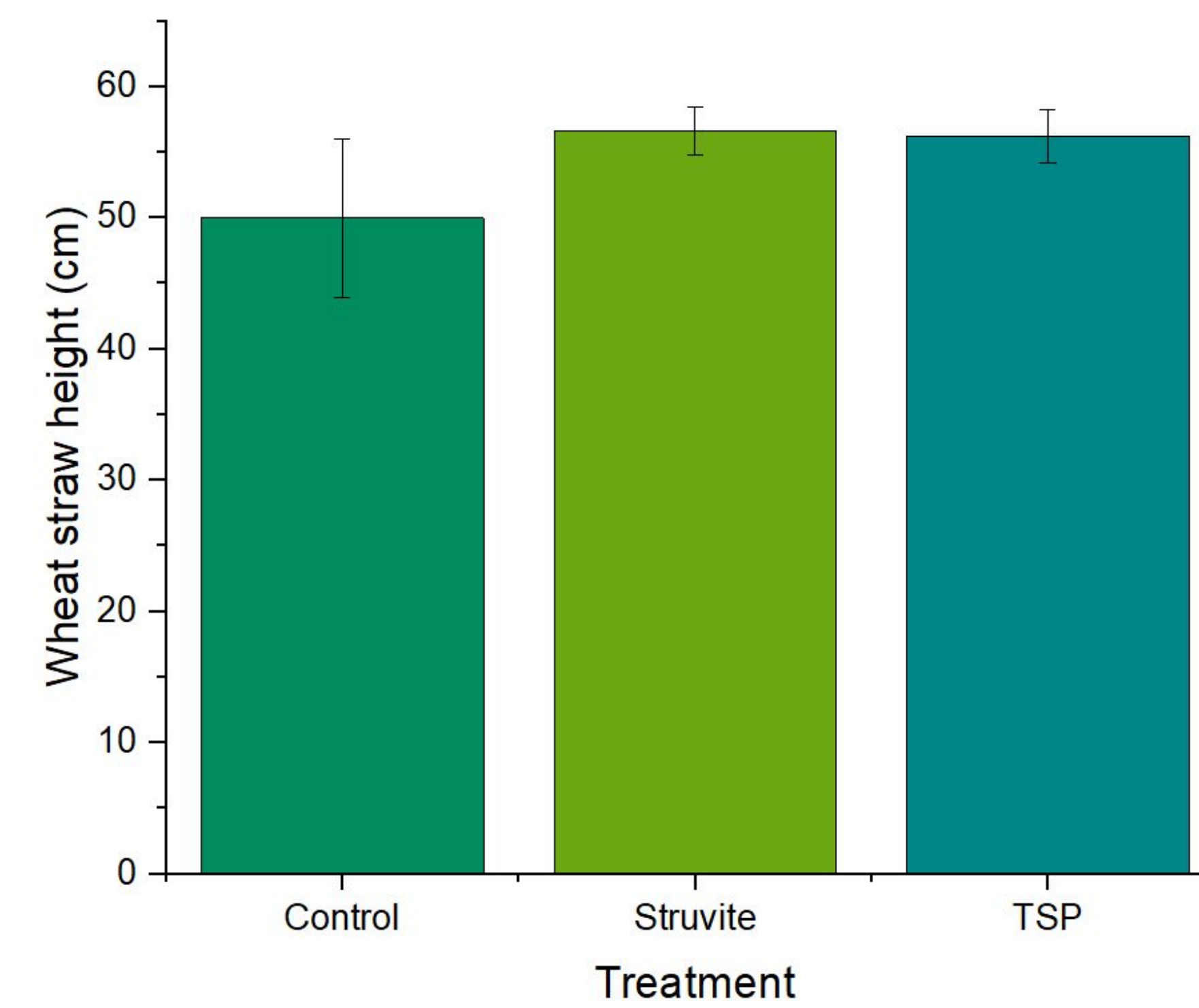


Figure 4.0 Effect of soil amendments (struvite & triple superphosphate) on wheat straw height

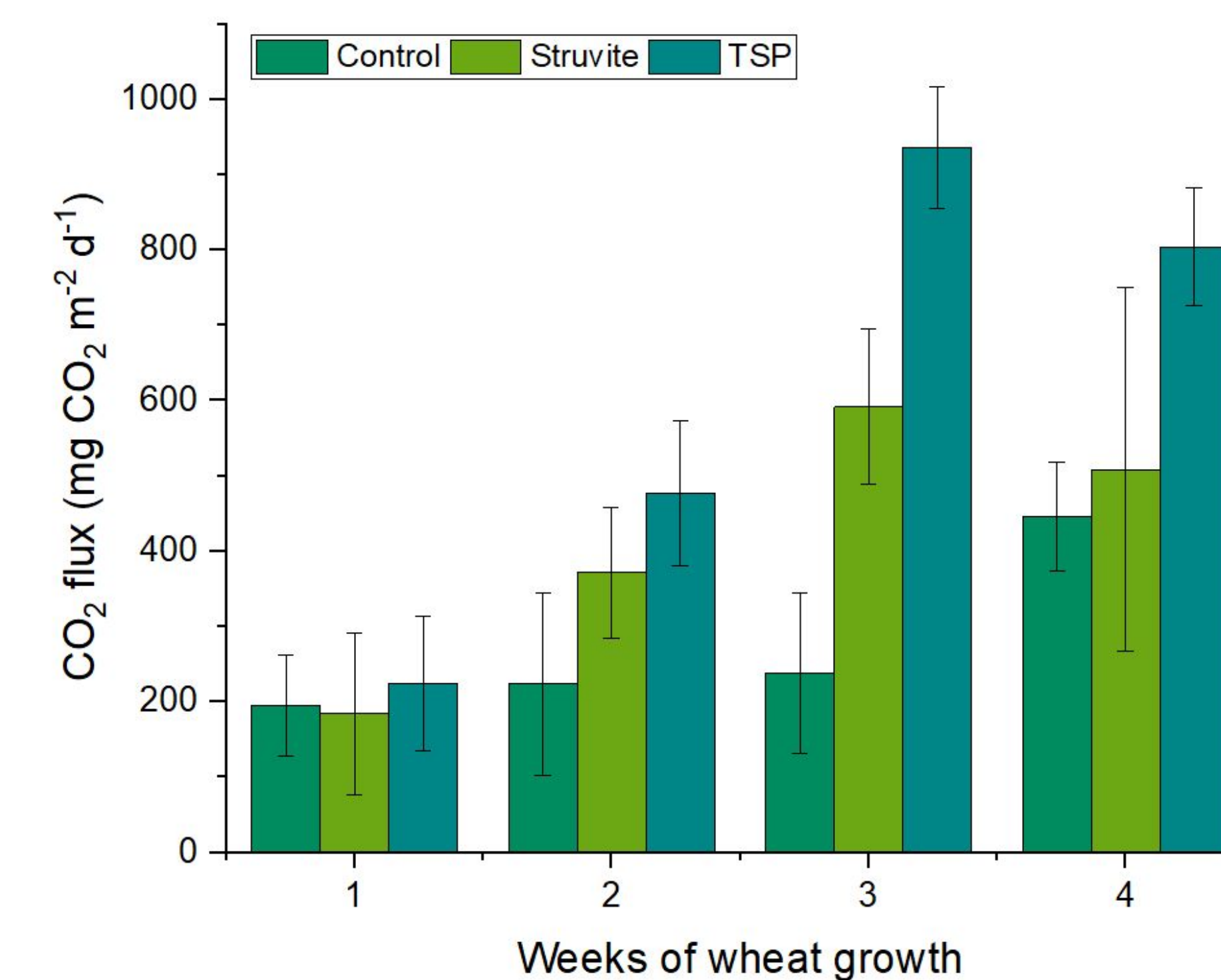


Figure 5.0 Effect of soil amendments (struvite & triple superphosphate) on carbon dioxide (CO₂) flux during wheat growth

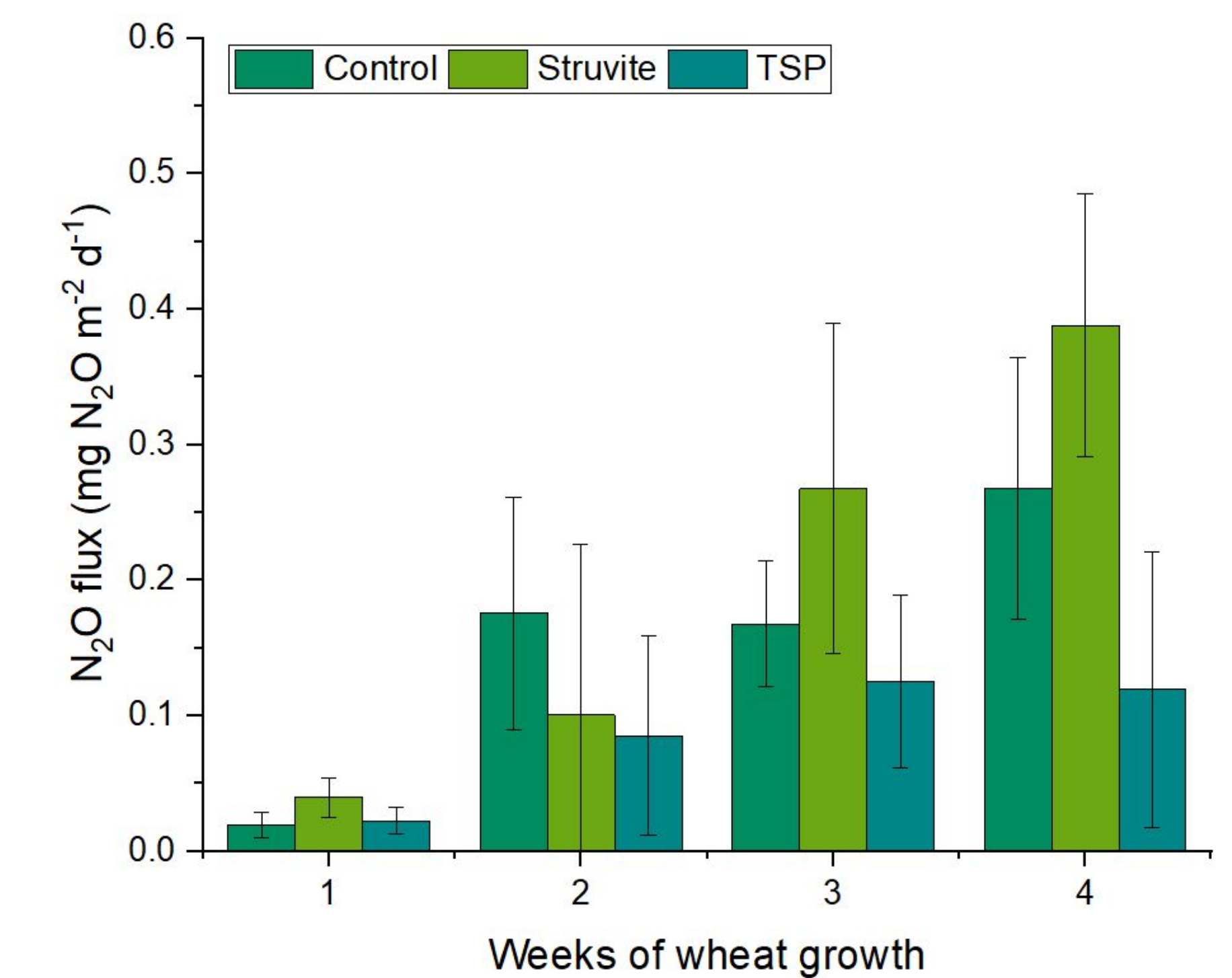


Figure 6.0 Effect of soil amendments (struvite & triple superphosphate) on nitrous oxide (N₂O) flux during wheat growth

Methods and Materials

Struvite Crystallization

- ❖ 1 liter of synthetic urine was mixed with 1:1 molar ratio of MgCl₂·6H₂O, which was stirred for 30 minutes and settled overnight.

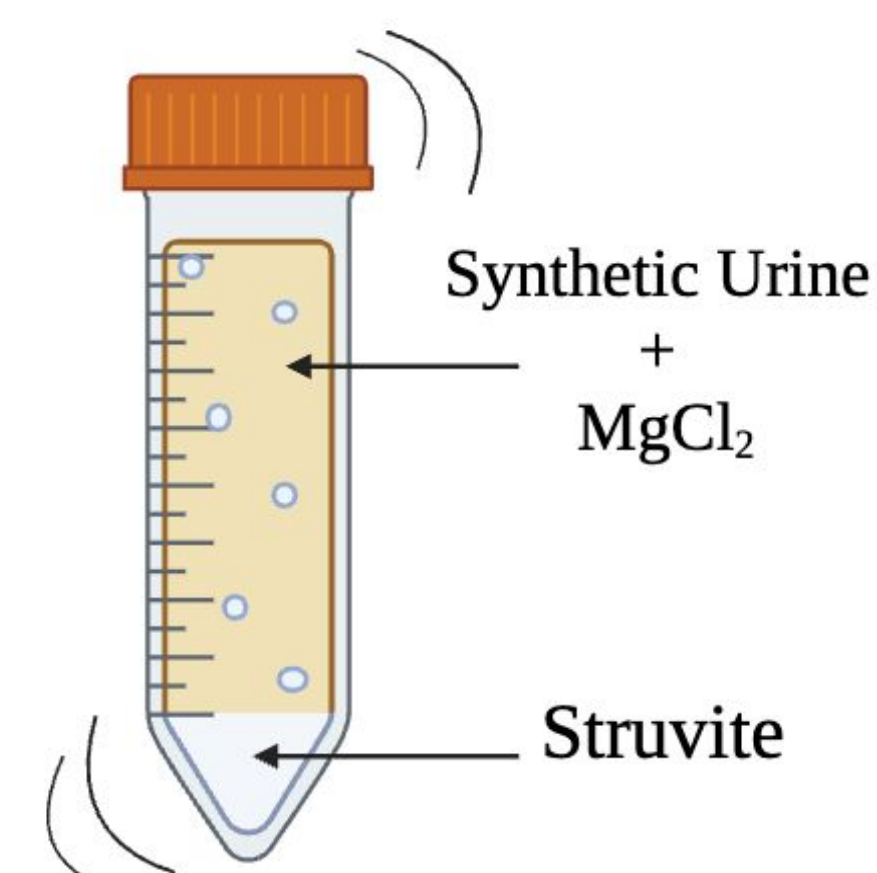


Figure 2.0 Nucleation and crystallization increase rate of struvite crystal formation.

Plant Growth Studies and Gas Collection

- ❖ Gray luvisol soil, collection from Breton plots, was conditioned before sowing the seed and fertilizer application, to stabilize the microbial bacteria.
- ❖ Bulk density and water holding capacity were maintained at 1:2 g cm⁻³ and 60%, respectively.

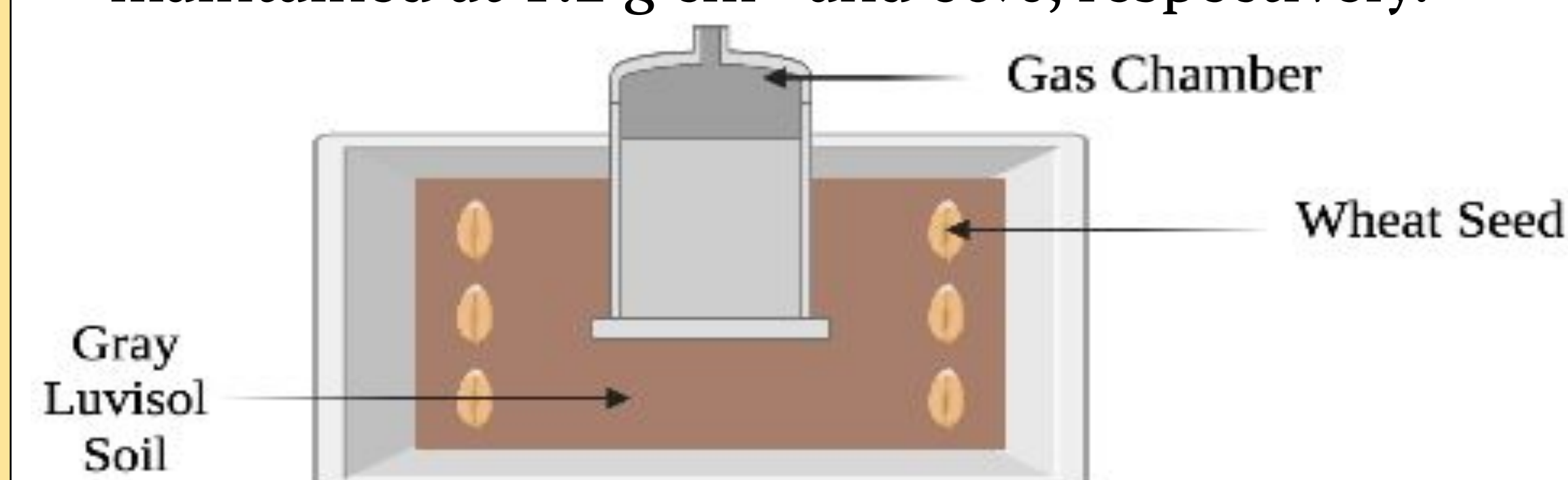


Figure 3.0 Experimental set-up used for plant growth and gas collection

Conclusion

- ❖ From the wheat straw height, it can be concluded that struvite can offer the same crop yield as TSP. These result indicates how the application of struvite fertilizer can be used competitively in the market while also promoting a more eco-friendly resource.
- ❖ The CO₂ emission of the struvite treatment was significantly less than the TSP during the four weeks of wheat growth
- ❖ The N₂O emission of the struvite treatment was higher than the TSP during the four weeks of wheat growth.

Future Work

- ❖ Laboratory rainfall-runoff simulation experiments.
- ❖ Sustainable agricultural practices with recycled fertilizer resource.
- ❖ Application of struvite fertilizer on various seeds.

Acknowledgements

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References

- [1] Ahmed, N., Shim, S., Won, S., & Ra, C. (2018). Struvite recovered from various types of wastewaters: Characteristics, soil leaching behavior, and plant growth. *Land Degradation & Development*, 29(9), 2864–2879. <https://doi.org/10.1002/ldr.3010>
- [2] Prem Pokharel, & Chang, S. X. (2019). *Manure pellet, woodchip and their biochar differently affect wheat yield and carbon dioxide emission from bulk and rhizosphere soils* 659, 463–472. <https://doi.org/10.1016/j.scitotenv.2018.12.380>