CIAT/Al Yedra

Using genetic diversity in deep root systems of forage grasses and rice to capture carbon in tropical soils

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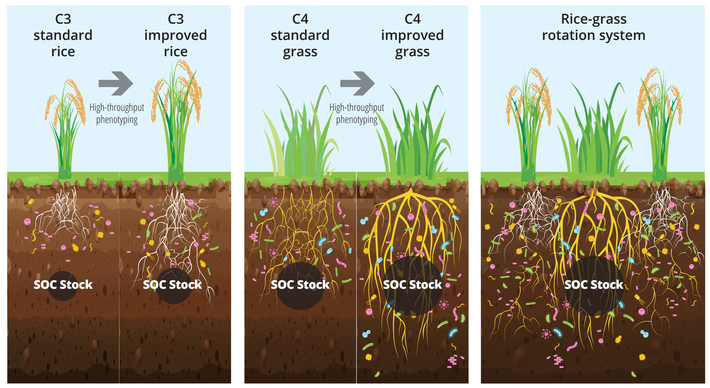
Introduction

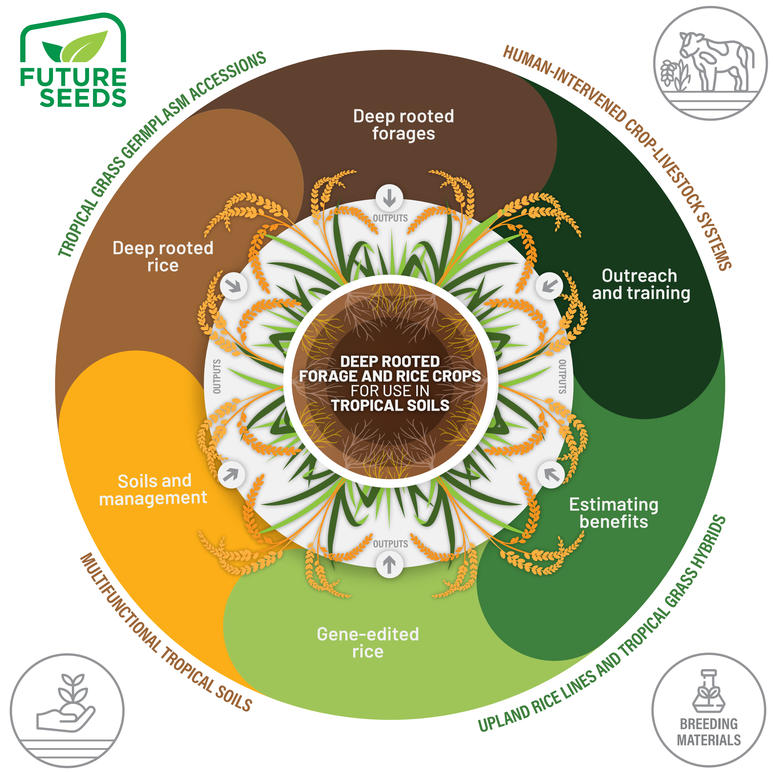
Plants capture carbon dioxide (CO_2) from the atmosphere by photosynthesis. Plant carbon (C) can be stored or sequestered in soil organic matter (SOM). Small increases in soil organic C (SOC) could help slow the increase in the concentration of CO_2 in the atmosphere and in so doing have considerable effects on the global climate system.

Hypothesis

Tropical forage grass and rice genotypes developed or designed with deep rooting ability improve storage of SOC in crop-livestock systems in the tropics while maintaining or increasing yields.



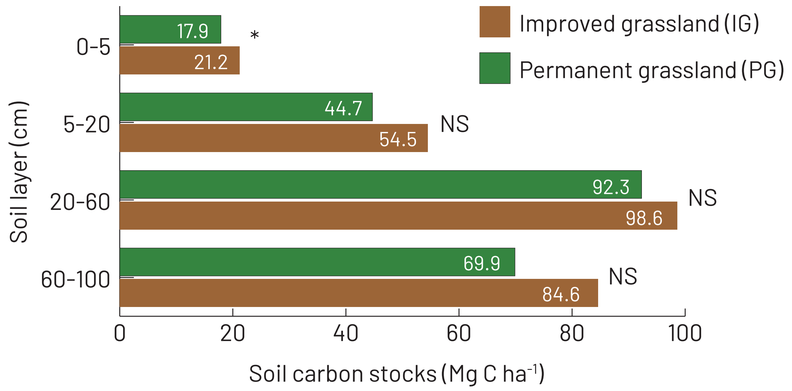
Objectives and outputs



1. Identification and development of deep-rooted tropical forage grasses for improved carbon storage in acid soils.
2. Identification and development of deep-rooted rice for improving carbon storage in tropical soils.
3. Deep rooting forage and crop components in crop-livestock systems replenish soil organic C in human-intervened areas in tropical soils of Latin America and Africa.
4. Gene editing technology applied to rice for improving productivity and C storage through deep rooting ability and photosynthetic efficiency.
5. Strategies developed to disseminate new root ideotypes of forage grass and upland rice for use in tropical soil regions of Africa and Latin America and benefits of effective C removals from the atmosphere estimated.
6. Forty young researchers trained in the areas of genetic diversity and carbon farming.

Preliminary results

Soil organic carbon stocks (0-100 cm soil depth) were higher in improved grasslands than permanent grassland (unmanaged savanna) in the Eastern plains of Colombia. Soil organic C accumulation potential of 2 t C/ha/yr in 0-20 cm soil layer was observed (Costa Jr et al. 2022).

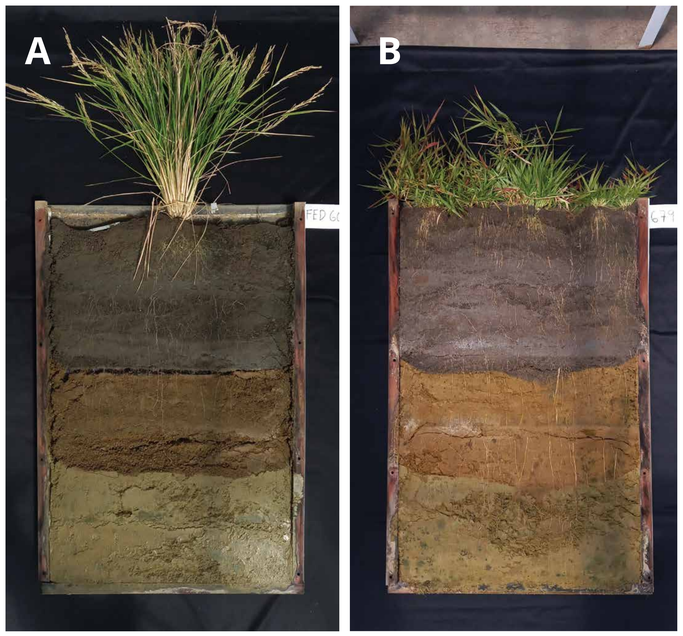


Abundance of soil macrofauna increased in sustainably managed grasslands compared to burned savanna and forest.

Land use	Individuals/m²
Urochloa humidicola	1,171 ± 365
Burned savanna	236 ± 64
Forest	144 ± 46

Biomass production of fine roots increased in rotationally-grazed *Urochloa* pasture compared to permanently-grazed and burned savanna. DM: dry matter.

Land use	Fine roots t DM/ha
Urochloa humidicola-rotational	1.43 ± 0.26
Urochloa humidicola-permanent	0.47 ± 0.04
Burned savanna	0.40 ± 0.06



- On top: *In situ* imaging of rice (A) and Grass (B) roots (0-150 cm) in a rice-forage rotation trial.
- Two out of 180 *Urochloa* grass genotypes identified as waterlogging-tolerant, which are suitable for rotation with paddy rice.

References

Costa Jr C; Villegas DM; Bastidas M; Matiz-Rubio N; Rao I; Arango J. 2022. Soil carbon stocks and nitrous oxide emissions of pasture systems in Orinoquía region of Colombia: Potential for developing land-based greenhouse gas removal projects. *Front. Clim.* 4:916068. doi: 10.3389/fclim.2022.916068

Acknowledgments

This work was done as part of the CGIAR Initiatives on Livestock and Climate; Agroecology; and Accelerated Breeding. We are grateful to all donors who globally support our work through their contributions to the CGIAR system. The opinions expressed in this document cannot be taken as official opinions of these organizations.

Poster presented at:
XXV International Grassland Congress
Kentucky, USA, May 14-19, 2023