# COPASOCS (ID 177)

## COmposite Polymer-based Amendments for Soil Organic Carbon Sequestration

**Coordinator**

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**Project partners**

| Country | Organization |
|---|---|
| **Argentina** | National Institute of Agricultural Technology |
| **Hungary** | Hungarian University of Agriculture and Life Sciences |
| **Italy** | University of Palermo |
| **Mexico** | Colegio de Postgraduados |
| **Uganda** | Makerere University |

**Summary**

Climatic changes that manifest themselves in progressing warming, aridization and extreme weather events are increasingly challenging for agriculture. New technologies, practices and management approaches are needed to increase farming systems' sustainability and resilience to climate change. One of the main threats to agricultural soils is water and wind erosion, becoming even more threatening due to climate change. Innovative polymer-based approaches may be a solution for soil stabilization, improving physical and chemical properties, and even simultaneously enhancing SOC sequestration. To avoid possible contamination of soil with polymers and their components, we propose promising products of coupling two polymers, one with anionic groups and the other with cationic groups. These products, known as interpolyelectrolyte complexes (IPEC), are co-polymers with rather extended hydrophilic and hydrophobic blocks. They interact with complementary areas on the surface of soil particles and stick them together. After deposition of an aqueous polycomplex solution over soil and drying, a protective layer forms on the surface with a thickness of ca. 5 mm, composed of polymers and soil particles. The protective layer ensures air and moisture exchange, thus providing plant growth. When destructed, the protective layer is completely restored after rainfalls or artificial irrigation. In addition to anti-erosion action, the polycomplex formulations allow water retention in the soil, intensify humification through regulating moisture and temperature regimes, bind heavy metals, etc. Finally, the polycomplexes, mixtures of carbon chain polymers, can deliver and store organic carbon in soils and serve as food for soil microorganisms, especially if one of the components is a natural polymer. We will test a synthetic polymer complex with humic substances (IPECHS), thus combining the stabilization and carbon sequestration effects. Also, we propose a novel technology based on the application of interpolyelectrolyte complexeswith rough organic excipients (IPECROE) such as mulch, coco coir, coffee sub-products, shrimp shells etc. By the varying composition of polymers and a polymer-to-polymer ratio, the adhesive properties of polycomplex formulations can be adjusted for treating different types of soil, from light sandy to heavy clay.In the present project proposal, we suggest refining and verifying the innovative methodology of applying the proposed IPEC, IPECHS, and IPECROE preparations in soils with contrasting mineralogy and corresponding physicochemical properties: Phaeozems, Retisols, Solonetz, Vertisols, Ferralsols, and Andosols. Correspondingly, field experiments will be established in Argentina, Russia, Hungary, Italy, Uganda, and Mexico. Possible effects on soil fauna and microbiome will be studied to avoid the negative impact of the technology on biodiversity. Also, we will compare the effect of the proposed technology on soil carbon balance under conventional and no-till management. Carbon dynamics will be monitored for two years through emission continuous measurements of greenhouse gases (GHG) sampled with field chambers and determined by chromatography and regular assessment of SOC stock in topsoil. The efficiency of the proposed technology will be assessed for different environments, and the potential

effect will be modelled using GHG estimations by IPCC Guidelines, and soil C by the Rothamsted model for different climatic scenarios. The economic efficiency will also be calculated based on the predictive models for different soils using the natural capital value approach. The project will be broadly disseminated to raise public awareness, foster improved societal understanding of the role of soil management for sustainable agricultural production, and promote the technologies developed in the frames of our research.

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