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8th World Congress on Conservation Agriculture

PROCEEDINGS OF THE 8th WORLD CONGRESS ON CONSERVATION AGRICULTURE

The future of farming

Profitable and Sustainable Farming with Conservation Agriculture

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Lessons learned from two long-term Conservation Agriculture experiments in Brazil and USA regarding soil functionality

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The scaling up of Conservation Agriculture (CA) relies on practical evidence of benefits, specific knowledge of how the system works, field training, and institutional and policy support. Some benefits of CA are realized in the short-term such as erosion control, conservation of soil moisture, decrease in soil temperature and weed control. Others, that are linked to ecological and sustainability functions require a certain period of time that can vary according to the soil and climate type, the range of improved agricultural practices applied, and level of land degradation at time when CA adoption process began. In order to achieve a high level of CA system organization and complexity, the system needs to gradually achieve intermediate phases of organization along an evolutionary pathway. Long-term experiments are crucial to understand changes that occur in soil quality in the medium to long-term. Restoration of soil organic carbon content has been associated with decrease in soil mechanical disturbance, promotion of biological diversity and increase in crop biomass input.

In CA systems, improvements in soil structure have been linked to well-developed root system of cover crops and crop rotation that stimulate soil fauna and microorganisms including fungi. In CA systems that achieve high level of organization, nutrient cycling and bioavailability, biological diversity, environmental buffer capacity, soil resilience, plant water availability, soil aeration and plant health are among the most important system properties that are observed. They also are characteristics that reflect system maturity. The interactions amongst the soil-plant-biological activity components can better explain the soil functionality of complex systems than the isolated indicators of each component. Achieving a high level of soil quality is a necessary goal in order to reduce temporal yield variability, to reduce dependence on external inputs, to provide environmental services, and to accomplish plant, animal and human health.

Two long-term experiments carried out in Brazil and USA with CA and complementary practices for more than three decades were revisited in order to understand the soil functionality in complex systems. The main lessons of these experiments were: a) frequent soil disturbance (conventional tillage) partially negated the positive effects of management improvement such as the adoption of cover crop and crop rotation (Brazil experiment) and organic fertilization (USA experiment); b) no-till without crop diversity and full soil biomass cover was not able to achieve the highest level of organization of the system even in the long-term; and c) the three interlinked principles of CA (continuous no or minimum mechanical soil disturbance, permanent soil biomass cover and crop diversification with rotation and/or association) when associated with complementary agricultural practices for a long period allow the restoration of depleted soil carbon not only in the shallow top layer but also at lower depths, supporting a diverse biological community that is coupled with a high level of organization and where the important emergent soil properties were also expressed.

The paper and the presentation will provide more details of the long-term experiments in Brazil and USA and the results obtained that explain the nature of the lessons learned.

Keywords: *scaling, adoption, organic carbon, cover crop, diversity*