Carbon Sequestration in Organic Maize/Soybean Cropping Systems

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Abstract

Compost, cover crops and no till were the chief agricultural practices identified for their carbon sequestration potential. A conventional maize/soybean crop system with no cover crops did not significantly (P=0.05) sequester carbon (range 100 to 340) and utilized 33% more energy than a diversified organic rotation of maize and soybean featuring cover crops. The Rodale Institute Farming Systems Trial® has shown organic wheat/maize/soybean cropping systems with cover crops sequestered ~1,000 kg C/ha/yr, (range 667 to 1,381). This potential for cover crops to sequester approximately 1,000 kg C/ha/yr was also confirmed by Veenstra et al 2006 in the San Joaquin Valley in California, who also demonstrated low effect of no tillage in comparison. Literature meta-analysis and long term conventional no till studies at Ohio State University show carbon sequestration rates of approximately 300 kg C/ha/yr (range 90 to 620) when cover crops were not utilized. In the Rodale Institute long-term Compost Utilization Trial, 1993 to 2002, compost lead to over 2,000 kg C/ha/yr sequestration while negligible carbon sequestration was found for manure. In this experiment, both compost and manure were applied to give the available nitrogen requirements for peppers in a maize, pepper, and wheat rotation with cover crops. Results from the Rodale Institute and literature review suggests integrative practices demonstrate the greatest potential to counter-balance global greenhouse gas emissions by sequestration compared to that of single agricultural practices used alone. An innovative cover crop roller in tandem with a no-till planter was used successfully in organic wheat/maize/soybean crop production systems. Organic no-till reduced diesel consumption over 70% compared to conventional tillage organic. A long-term evaluation of the system's Carbon sequestration has been initiated. Cover crop usage, soil aggregate amounts and stability in water, mycorrhizae spore counts and glomalin concentrations for mycorrhizal fungi correlate well with Carbon accrual in deep soil profile analyses. Overall greenhouse gas impact of agricultural/food systems require a holistic analysis combining assays of: i) production energy requirements, ii) crop yield levels, iii) system carbon sequestration capacity, and iv) energy required for food processing and v) energy needed for food distribution. Developing comprehensive greenhouse gas analyses of food and agricultural systems will provide better informational base as a foundation for policy development and also better inform consumer of their choices in their of their greenhouse gas footprints. The integrative and holistic analysis proposed is germane since only one quarter to one third of total food energy requirement is governed by fossil fuel used in production while the majority is related instead to food processing, packing, and distribution. In addition, carbon sequestration is potentially of greater impact than emission control as a means of balancing greenhouse gas and its impact. The food/agriculture system represents a major and underestimated sector in relation to greenhouse gas issues.

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