Comparison of Water, Carbon, and Nitrogen Mass Balance in C-S-W Rotations under Organic and Conventional Production Management Systems

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INTRODUCTION

Both hydrology and soil quality are affected by land management. Land management for increased and sustained crop production is essential to feed the expected growth in world population. Crop production management systems differ in economic and biological sustainability. Organic production systems offer environmental benefits in addition to improving and sustaining soil health. There is inadequate information available to guide producers regarding the adoption of organic crop production systems.

The CSCAP project seeks to increase resilience and adaptability of Midwest agriculture to more volatile weather patterns by identifying farmer practices and policies that increase sustainability while meeting crop demand.

OBJECTIVES

1) Quantify the hydrology and soil quality aspects of C-S-W rotations under organic and conventional production management systems
2) Compare water use efficiency of C-S-W rotations under organic and conventional production management systems
3) Compare soil C and N status of C-S-W rotations under organic and conventional production management systems

NAEW-The Ohio Location

The North Appalachian Experimental Watershed (NAEW), located on 1,047 acres of sloping land north of Coshocton, Ohio was established in 1935 by the U.S. Department of Agriculture to search for better farming methods on sloping land and conduct unique hydrology and water quality studies.

Seven small watersheds equipped to measure and sample runoff are managed to have each phase of both systems present each year. Soil water content is monitored continuously in each watershed, and soil and biomass samples are collected and analyzed to determine C and N inputs and status annually. Seven monolith lysimeters are equipped to measure and sample percolate and runoff from one phase of both systems each year as well.

Organic versus Conventional No-Till Production Systems at NAEW

The conventional system is based on no-till and uses commercial fertilizer with pesticides to manage weeds. The rotation is corn-soybean-wheat with a cover crop of cowpeas, oilseed radish and sun hemp seeded following wheat harvest.

The organic system includes tillage as needed and uses poultry manure with annual cover crops to manage weeds. The rotation is corn-cereal rye cover-soybean-wheat with cover crops of cowpeas, oilseed radish and sun hemp seeded following wheat harvest.

Minnesota-A Sister Project

The University of Minnesota Southwest Research and Outreach Center is home to a plot-scale long-term experiment, Variable Input Crop Management Systems evaluating the agronomic, economic, and environmental performance characteristics of organic and conventional crop management systems. The project consists of two and four year rotations under conventional and organic cropping systems. The four year rotation consists of corn, soybean, oat-alfalfa and alfalfa whereas the two-year rotation consists of corn followed by soybean. It is important for the scientific integrity and extrapolation of the results to have a similar experimental design conducted at one or more additional locations in the Midwest with different soil and environmental conditions.

RESULTS AND DISCUSSION

Weed control has been a serious issue preventing successful adoption of the organic system. Late planting of wheat in the fall of 2011 due to wet conditions exacerbated the weed problem. Weeds flourished during the summer drought in 2012 overtaking all the crops. Weed biomass was sampled and the C and N content was determined. Crop failure ensued and the biomass was baled and removed to allow planting of additional cover crops to create a surface mat of residue and also generate allelopathic effects to inhibit weed dominance. Wet conditions following planting in 2013 also exacerbated the weed problem by preventing timely cultivation in the corn phase.

CONCLUSION

Conversion to organic production is difficult and uncertain to succeed at a significant scale, but may be appropriate for small farms.

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