Time and topography affect cover crop contribution to soil particulate organic matter

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INTRODUCTION

The benefit of cover crops in carbon sequestration, nutrient supply, pest and weed controls have been well documented, however; contrasting findings have been reported on the benefits of cover crops. This could be attributed to variations in soil types, topography and short-term natures of most of previous studies. The objectives of the present study are to investigate the role of duration of cover crop based management on carbon sequestration, and examine the effects of topographic positions on carbon sequestration.

MATERIALS AND METHODS

- Row crop systems with three durations of cover crop management were investigated: short-term (one yr), medium term (six yr) and long-term (24 yr) studies that located at Kellogg Biological Station (KBS) and Mason.
- Particulate organic matter (POM), soil organic matter (SOM), and dry aggregate size distribution were analyzed.

The marks on the map showed different study periods and sampling points

KBS-CAP 1 yr
KBS-Scales up 6 yr
KBS-LTER 24 yr

Fig. 1 Map of Kellogg Biological Research Station Fields

The three study periods shared common treatments: (i) conventional corn/soybean/ rotation without cover crop (ii) Reduced input corn/soybean rotation with cover crop. Landscape positions included in short and -medium term studies as slope, depression, and submit.

RESULTS

Despite numerically higher POM in cover crop management, in medium- and short- term management systems, the differences were rarely statistically significant (Figs 2 and 3). POM concentrations at depressions were significantly higher than that of slope and summit positions.

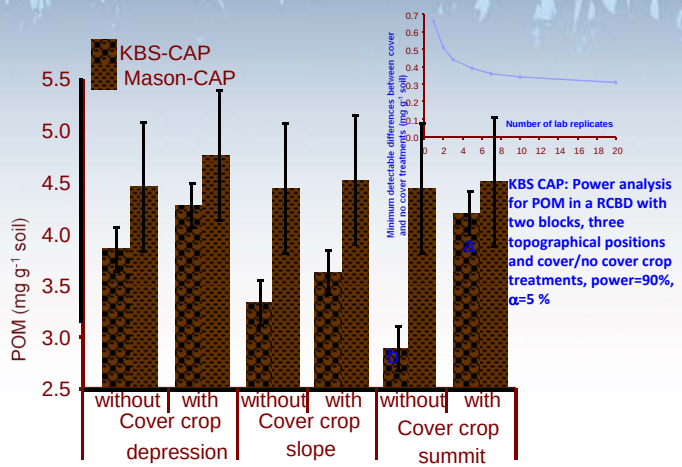
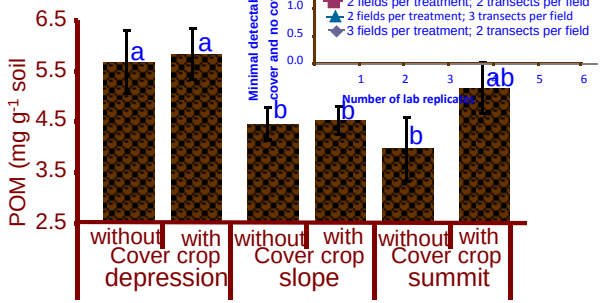


Fig. 2 Short-term cover crops based management effects on POM concentrations at KBS and Mason

Scales up: Power analysis for POM in a RCBD with three fields per cover crop treatment, two transects per field, three topographical positions and cover/no cover crop treatments, power=90%, a=5 %



Columns indicated by different letters within each cover crop treatment are significantly different at (P<0.05).

Fig. 3 Medium-term cover crop based management effect on POM concentrations at KBS

In the long-term system, POM under cover crop management was twice that of the conventional management, and cover crops also significantly increased the overall SOM (Fig. 4). Long-term cover crop based management also affected dry aggregate size distributions (Fig. 5).

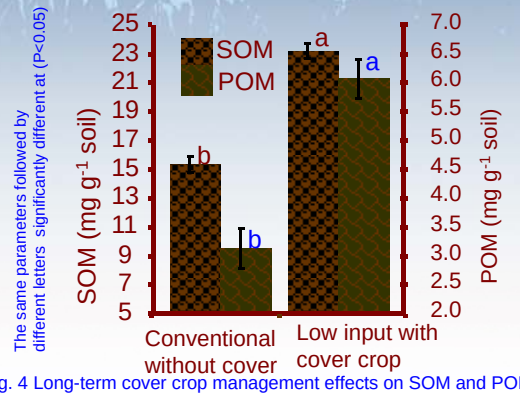


Fig. 4 Long-term cover crop management effects on SOM and POM concentrations at KBS

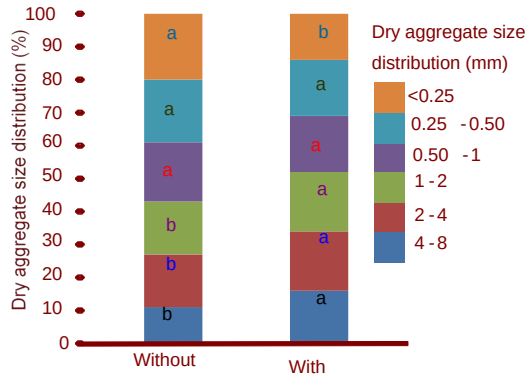


Fig. 5 Long-term cover crops management effects on dry aggregate size distribution at KBS

CONCLUSION

Carbon sequestration in cover crop management depends on duration of the management system, soil types, and topography. In certain soils and topographies the changes in fast responding soil variables, such as POM, can become evident even after a single season of cover crops. However, across large agricultural fields with diverse terrain the variability in cover crop effects on POM can be extremely high.

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KBS LTER Kellogg Biological Station Long-term Ecological Research

SUSTAINABLE CORN.ORG CROPS, CLIMATE, CULTURE AND CHANGE

USDA United States Department of Agriculture National Institute of Food and Agriculture