Irrigation System and Tillage Effects on Soil Carbon and Nitrogen Fractions

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Introduction

Conventional irrigation systems, such as and furrow and Mid-Elevation Sprinkler Irrigation (MESA) have low water application efficiency (35 to 80%) and increase loss of water soluble C and N through surface runoff and leaching. Similarly, conventional tillage increases soil erosion, seedling damage by windblown soil, and fuel cost, reduces organic matter. Alternative irrigation system, such as Low Energy Precision Application (LEPA) and reduced tillage are needed to improve water application efficiency, increase soil organic matter, and reduce erosion.

Objective

Evaluate the effects of irrigation systems (MESA and LEPA) and tillage (conventional and strip tillage) on surface residue and soil labile, nonlabile, and available C and N fractions at the 0- to 20-cm depth from 2004 to 2007 in eastern Montana.

Treatments

Two irrigation systems:

- Mid-elevation spray application (MESA): Water applied from nozzles, 3 m apart , at a height of 1 m at 0.40 L s-1 .
- Low energy precision application (LEPA): Water applied from nozzles, 1.2 m apart, at a height of 15 cm at 0.16 L s-1.

Total amount of water applied was 3.8% more in MESA than in LEPA.

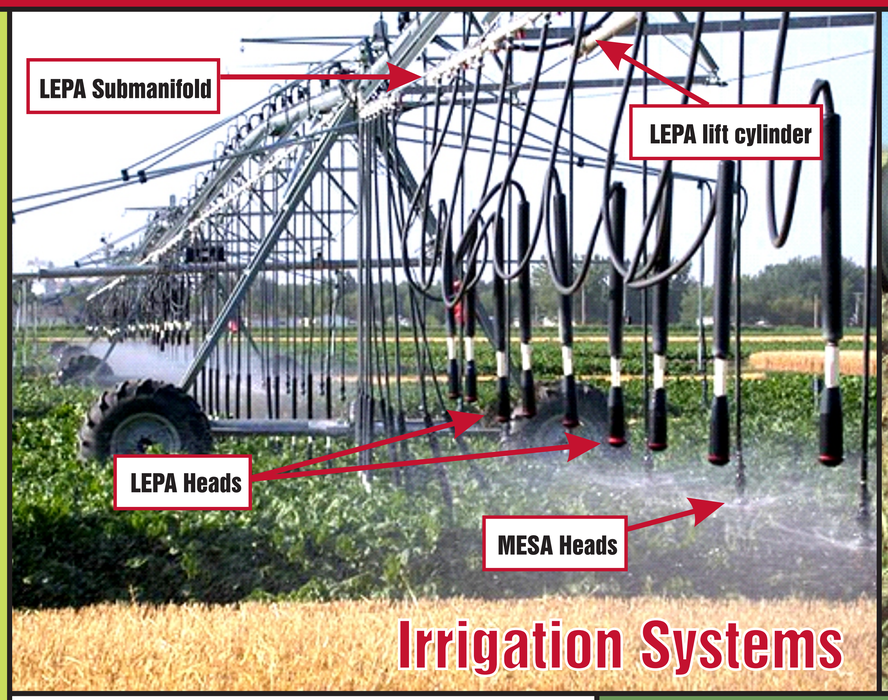
Two tillage practices:

- Conventional tillage (CT)
- Strip tillage (ST) (or reduced tillage)

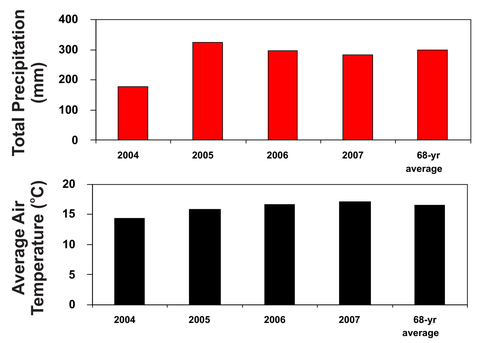
Unbalanced stripped block design with four replications

Results and Discussion

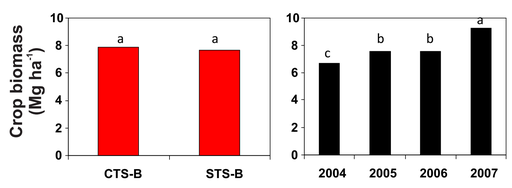
- Crop biomass **was not influenced** by irrigation system and tillage.
- Strip tillage **increased** surface residue, N storage, and microbial biomass at the surface soil, especially in LEPA compared to conventional tillage.
- Residue incorporation to a greater depth due to conventional tillage **increased** C storage, microbial activity, and N mineralization and availability in the subsurface soil.
- Application of water at a slower rate **promoted** microbial biomass N in the LEPA system.



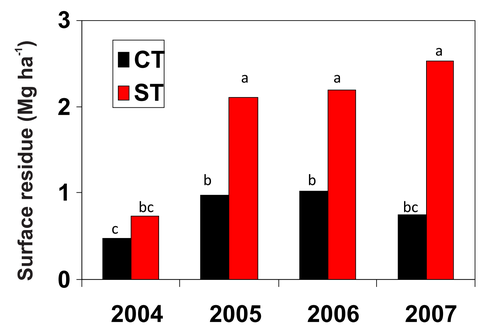
Precipitation and Temperature (April-September)



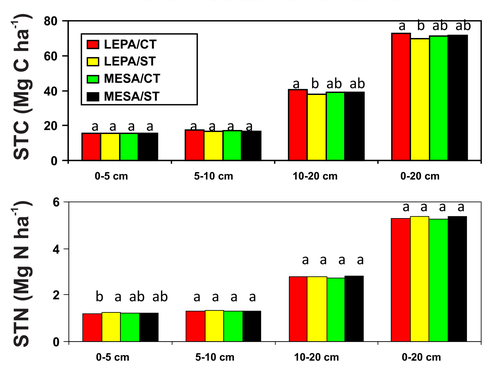
Crop biomass



Soil surface residue



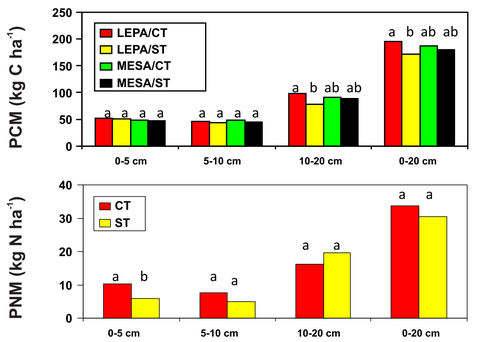
Soil total C and N



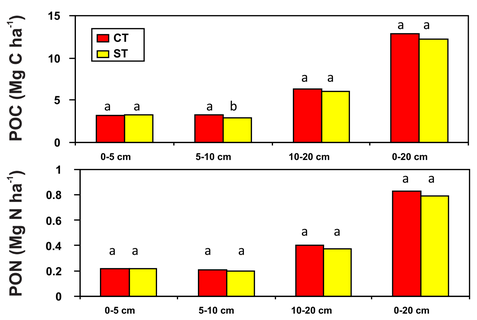
Conclusion

Reduced tillage in the LEPA system may increase surface residue, soil C and N sequestration, microbial biomass, and N availability, thereby improving soil quality and reducing the potentials for soil erosion and seedling damage due to windblown soil without affecting sugarbeet and malt barley yields.

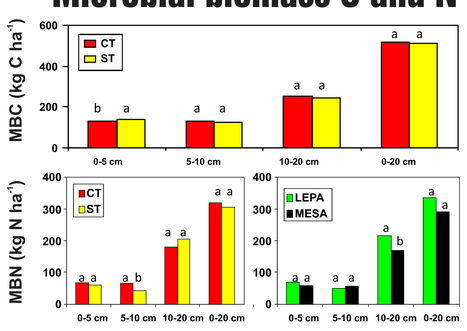
Potential C and N mineralization



Particulate organic C and N



Microbial biomass C and N



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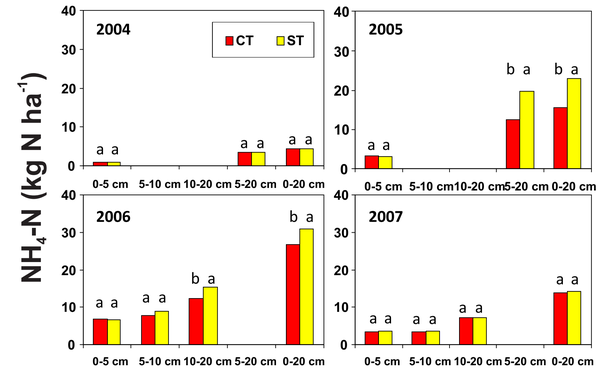
Soil ammonium - nitrogen



Soil nitrate - nitrogen