WARMING EFFECTS ON SOIL CARBON AND NITROGEN MINERALIZATION IN DRYLAND CROPPING SYSTEMS IN THE PACIFIC NORTHWEST

Rajan Ghimire[1], Stephen Machado[2], and Prakriti Bista[2]

[1]New Mexico State University Agricultural Science Center at Clovis, NM

[2]Oregon state University Columbia Basin Agricultural Research Center, Pendleton, OR

INTRODUCTION

- Intensive cultivation of native grassland for dryland agriculture has depleted soil organic carbon (SOC) and nutrients.
- Global warming may accelerate SOC and nitrogen (N) loss through its effects on mineralizable and easily decomposable fractions of soil organic matter.
- Improved understanding of SOC dynamics under ambient and elevated temperature can provide information needed to maintain soil health while improving crop production under changing climate.
- We evaluated the effects of soil warming on SOC and N mineralization in winter wheat (*Triticum aestivum* L.)-based production systems in the Pendleton long-term experiments (PLTEs).

OBJECTIVE

- Evaluate effects of long-term cropping systems management on SOC and N dynamics in winter wheat-based production systems.
- Determine effect of warming on SOC and N mineralization under alternative cropping system management practices.

MATERIALS AND METHODS

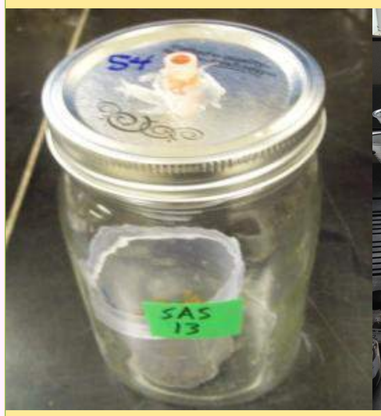
- ***Research site:*** Columbia Basin Agricultural Research Center near Pendleton, OR.
- ***Climate:*** Semiarid temperate, average annual precipitation 421 mm.
- ***Soil type:*** Walla Walla silt loam (coarse-silty, mixed, superactive, mesic Typic Haploxerolls).
- ***Years under current management :*** Undisturbed grassland: 1931-2015 , WW-SF: 1940-2015, WP: 1964-2015.
- ***Soil sampling and analysis:*** Summer 2015.

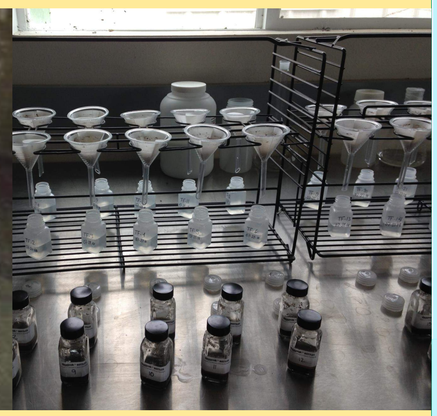
Table 1. Treatments and management history since establishment of the long-term experiments at CBARC, Pendleton, OR.

Treatment	Cropping system	Plot establishment	Tillage	N management
GP	Perennial grasses	1931	-	-
WW-SF	Winter wheat-summer fallow	1940	MB plow	90
WP-CT	Winter wheat - pea	1964	MB plow	90
WP-NT	Winter wheat - pea	1964	NT since 1995	90

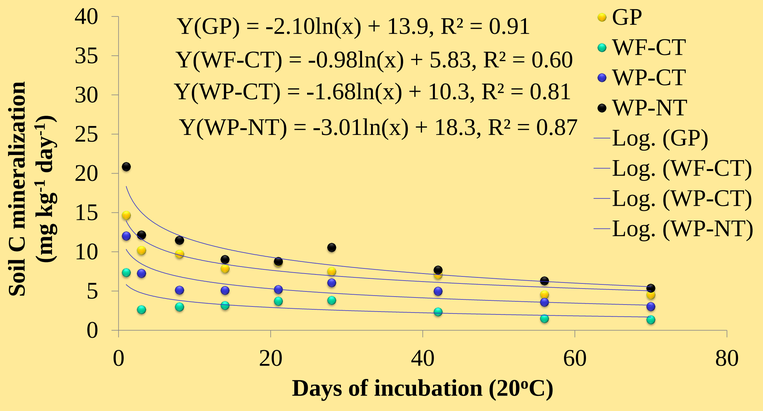
Soil sampling and laboratory analysis

- Soil samples were collected from 0-10 cm depth from selected long-term treatments in the PLTEs.
- Four soil cores were collected from each plot, composited, thoroughly homogenized, and approximately 500 g samples were used for laboratory analysis.
- Soil samples were brought to field capacity and incubated at 20°C and 30°C for 70 days to measure potential C mineralization.
- 10-g incubated samples were extracted in 50 ml 1M KCl and analyzed for potential N mineralization.





RESULTS



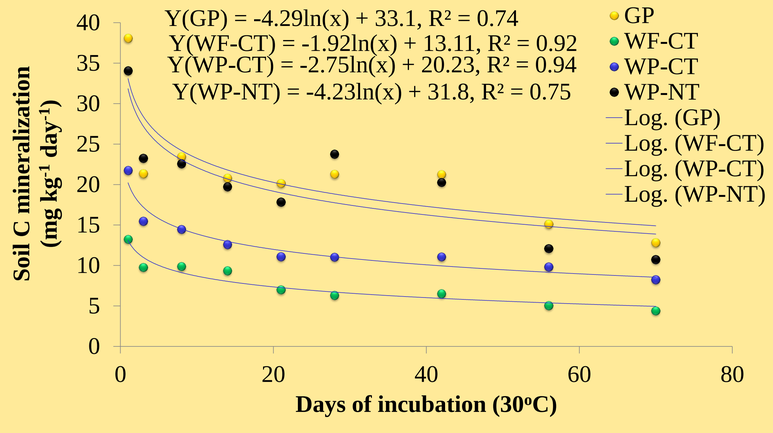
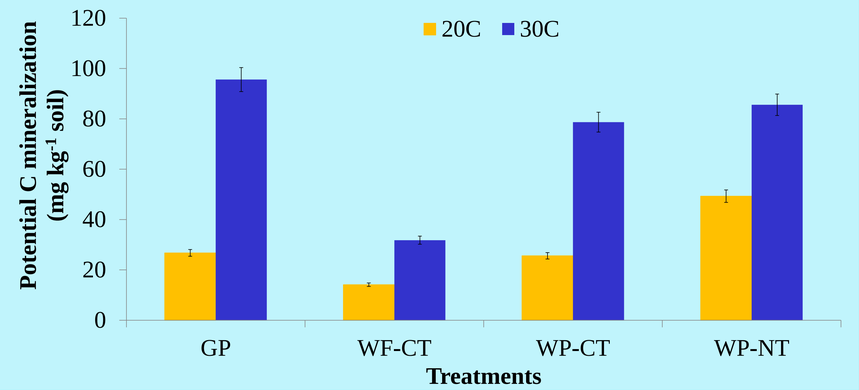


Figure 1. Soil C mineralization rate at 20°C and 30°C incubation as influenced by cropping systems and tillage management.

Effect of warming on soil C and N mineralization

- The rate of C mineralization was the highest under WP-NT and followed a trend of WP-NT>GP>WP-CT>WF-CT at 20°C.
- The rate of C mineralization was 1.7-3.6 times greater in 30°C than in 20°C.
- The rate of C mineralization followed the trend of GP>WP-CT>WF-CT>WP-NT under elevated temperature.
- Potential N mineralization was not significantly higher in 30°C than in 20°C.



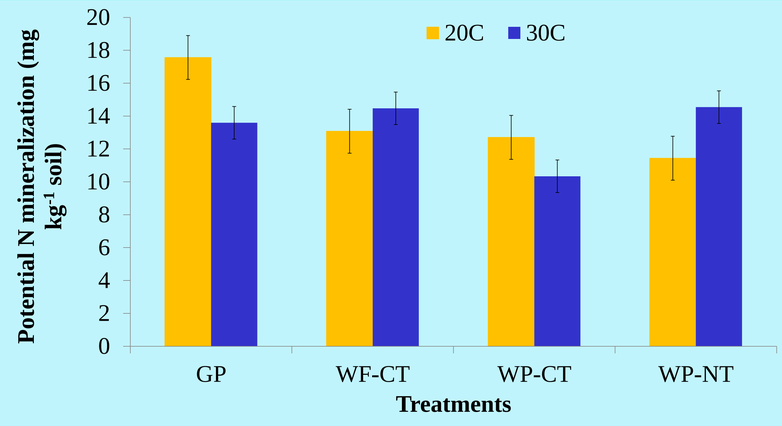


Fig. 2. Potential C and N mineralization at 20°C and 30°C incubation as influenced by cropping systems and tillage management.

CONCLUSIONS

- Increase in C mineralization under elevated temperature suggests high potential of SOC loss as the climate warms.
- Soil C mineralization may be limited by N mineralization potential under elevated temperature.
- No-tillage and legume integration in cropping system could minimize impact of warming on SOC loss.

Acknowledgements

This research is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2011-68002-30191) and additional support from the Columbia Basin Agricultural Research Center.

Contact: *rghimire@nmsu.edu*