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Does photodegradation drive surface litter decomposition in grasslands?

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Overview of Research Project

mposition is the primary process by which carbon and nts are cycled from plants to the soil and atmosphere. odegradation, the break-down of chemical compounds by iolet (UV) radiation, may contribute substantially to mposition of surface litter, especially in areas with high ration of solar radiation to the litter layer and relatively low bial activity such as arid and semi-arid grasslands. The bution of photodegradation to decomposition rates and the anisms by which photodegradation affects carbon and nt cycling are not well known.

ctives:

antify the relative contribution of photodegradation to ce litter decomposition in grasslands across a gradient of diation in the central United States.

termine the mechanisms by which photodegradation affects n cycling through a series of laboratory experiments.

ackground

nt studies have found xposure of surface o UV radiation during mposition increases mposition rates in arid emiarid environments. previous work in ado shortgrass e, I found that surface exposed to UV ion decomposed at a cantly faster rate dry conditions in litter ad a high carbon to en ratio (Fig. 1).

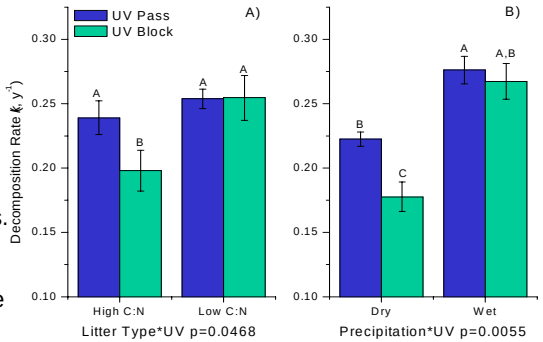

Fig. 1. Effect of UV on decomposition rates in Colorado for 3 years. Litter was screened from UV (Block) or exposed to UV (Pass). A) UV*Litter Type: Litter was grown under elevated or ambient CO_2 resulting in different carbon to nitrogen (C:N) ratios (elevated CO_2 increased C:N). B) UV* Precipitation: Precipitation scenarios were employed to simulate a wet or dry year.

Objective 1: Cross-site quantification

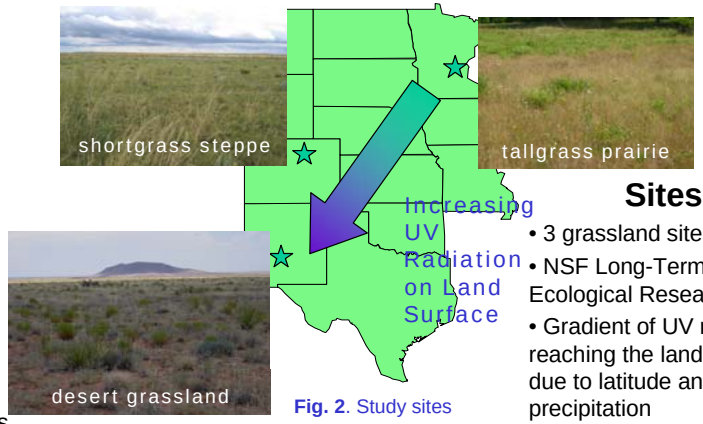

Fig. 2. Study sites

Sites

- 3 grassland sites (Fig. 2)
- NSF Long-Term Ecological Research Sites
- Gradient of UV radiation reaching the land surface due to latitude and precipitation

Approach

- Factorial design of UV and litter chemistry at each site
- Litter:
  - •2 grass species of contrasting chemistry
- •UV treatments:
  - Designed UV screens made of special clear plastic sheeting that either blocks 90% of UV-A and UV-B radiation or passes 90% of UV-A and UV-B radiation (Fig. 3).
  - Louvered design that faces south, allowing precipitation to reach the surface and minimizing temperature effects.
- Litter will be collected at four times during the 3-year field experiment.
- Litter will be analyzed for mass loss, changes in chemistry, and microbial activity and abundance.

Fig. 3. UV screen design and litterbags.

Objective 2: Mechanisms

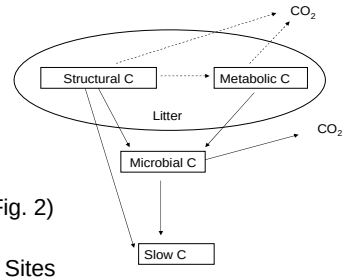

Fig. 4. Solid lines: known C fluxes. Dashed lines: proposed C fluxes from photodegradation

Photodegradation could increase the rate carbon cycling by 2 mechanisms (Fig. 4):

1. Direct oxidation of carbon compounds to gaseous forms (mainly CO_2).
2. Facilitation of microbial decomposition leading to higher respiratory fluxes of CO_2.

I will use a series of controlled laboratory experiments to separate these two mechanisms.

Significance

The results of this study will increase our understanding of patterns and mechanisms of the decomposition process in grasslands. In addition, study will improve the accuracy of biogeochemical models under current environmental conditions as well as increase our ability to predict future rates of decomposition due to changes in UV radiation at local, regional, and global scales.

Acknowledgments

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