Short-Term Leaf Litter Decomposition on the Santa Rita Experimental Range

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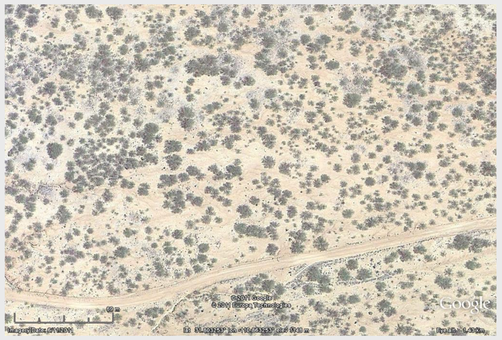
Introduction

- Decomposition, the process of breaking down organic material into its physical and chemical constituents, is a key determinant of soil fertility and an important component in the cycling of carbon and nutrients through an ecosystem.
- Climatic variables predict decomposition rates in mesic systems reasonably well, but underestimate the actual amount of decomposition that occurs in drylands. Photodegradation has been proposed as an important, but overlooked, factor in this discrepancy.
- The importance of solar ultraviolet (UV) radiation in litter degradation is uncertain: some studies show strong UV effects and others show no UV effects.
- Most decomposition studies are conducted over relatively long timescales (months to years) and may therefore miss rapid mass losses that occur during the first few weeks.

Objectives

- Quantify the influence of radiant energy exposure (full sun vs. shade) and UV radiation on the decomposition of *Prosopis velutina* leaf litter during a short (4 week) time period in a semiarid environment.
- Characterize the rates and dynamics of litter mass loss during the initial stages of decomposition under field conditions.

Study Site



- Litterbags were deployed on the Santa Rita Experimental Range (SRER), a 21,513 ha semiarid grassland site in SE Arizona (~80 km south of Tucson, AZ).
- The study was conducted in the mesquite-grassland zone at 1148 m elevation (31° 48' 12.125" N lat., 110° 51' 47.520" W long.)

Methods

Litterbags

- 10 × 10 cm; deployed on 13 July 2011
- Constructed with 20 × 20 mesh (~0.9 mm openings) fiberglass window screen back and a plastic front; filled with ~1.3 g of dried *P. velutina* leaflets
- Edges stapled; plastic front was perforated (twenty-four 1.6 mm diameter holes) to allow for the exchange of air and moisture

Sample Manipulation

- UV Environment –
  - Aclar – control, UV transparent plastic (= UV present = UV+)
  - Mylar – UV-B absorbing plastic (= UV absent = UV–)
- Level of Radiant Energy Exposure –
  - Intercanopy Zone – bare ground between shrubs receiving full sun
  - Subcanopy Zone – shaded area beneath a *P. velutina* canopy

Intercanopy Zone Placement

Subcanopy Zone Placement

- 25 litterbags in each of the experimental treatment combinations: UV+/intercanopy, UV+/subcanopy, UV–/intercanopy, and UV–/subcanopy
- 5 litterbags from each combination collected at weeks 0, 1, 2, 3, and 4
- Soil-surface temperatures (in litterbags and on bare ground), levels of photosynthetically active radiation, precipitation, and soil moisture were monitored during the 4-week study

Results

- Temperatures in UV+ and UV– litterbags were statistically comparable ($p = 0.6544$)
- Soil temperature (Fig. 1) and photosynthetically active radiation (data not shown) was greater in the intercanopy zone than in the subcanopy zone ($p < 0.0001$)

Figure 1 – Average daily temperature (monitored hourly) on bare soil in intercanopy and subcanopy zones.

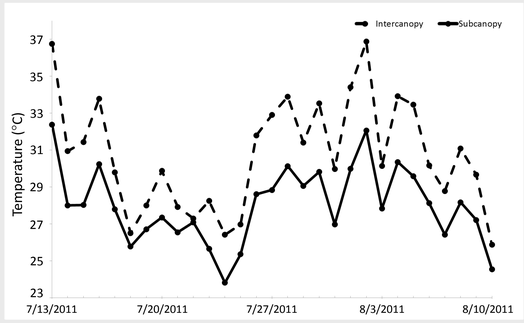
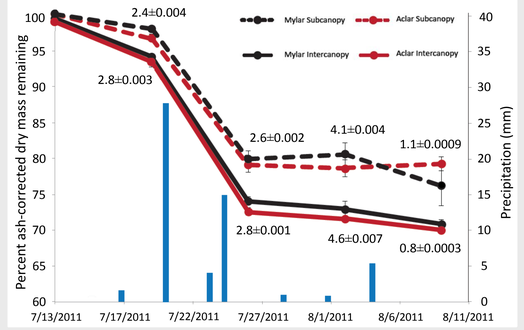


Figure 2 – Mean (±1 S.E; n=5) ash-corrected mass loss (scaled so time 0 values start at 100% and represent initial litter mass). Numerical values associated with each harvest date indicate mean (± S.E.) soil moisture in intercanopy and subcanopy placements. Bars represent the daily precipitation.



- Near-surface soil moisture was statistically comparable in intercanopy and subcanopy placements ($p = 0.7817$)
- Litter decomposition rates in intercanopy zones were significantly higher than those in subcanopy zones (Fig. 2; $p = 0.0303$)
- Manipulation of UV radiation had no significant effect on decomposition rates (Fig. 2; $p = 0.8012$)

Conclusions

- Although short-term decomposition of litter was strongly influenced by overall levels of radiant energy exposure, it was not affected by UV wavelengths.
- Rates and dynamics of short-term decomposition were closely related to the amount and timing of precipitation.

Acknowledgements

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