Leaf litter decomposition in drylands: how do microbes get water when it doesn't rain?

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BACKGROUND

Decomposition is a fundamental process in biogeochemical cycling. However, current models underpredict plant litter decomposition rates in drylands. Unique "dryland mechanisms" are likely at play. In particular, non-rainfall moisture may wet litter and stimulate microbial activity.



"Dryland Mechanisms" that might enhance decomposition:

Photodegradation
Thermal Degradation
Soil-Litter Mixing
Non-rainfall Moisture

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RESEARCH QUESTION AND HYPOTHESES

How does non-rainfall moisture influence litter moisture and decomposition? We hypothesize that plant litter equilibrium moisture content will increase with increasing relative humidity. We predict that decomposition rates, measured via mass loss and [CO_2], will also increase with increasing relative humidity.

EXPERIMENTAL DESIGN

We are conducting a series of laboratory incubation experiments to measure litter water holding capacity, litter equilibrium moisture content, litter mass loss, and microbial respiration over time across different relative humidity levels.



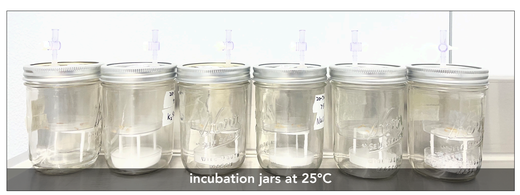


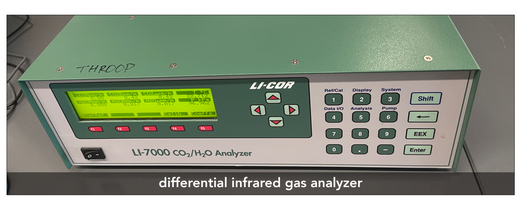




	Relative Humidity at 25°C
Pure Water	100%
Potassium Sulfate (K_2SO_4) Saturated Solution	97%
Potassium Chloride (KCl) Saturated Solution	84%
Sodium Chloride (NaCl) Saturated Solution	75%
Magnesium Chloride ($MgCl_2$) Saturated Solution	33%
Drierite (Anhydrous $CaSO_4$)	3%







PRELIMINARY RESULTS

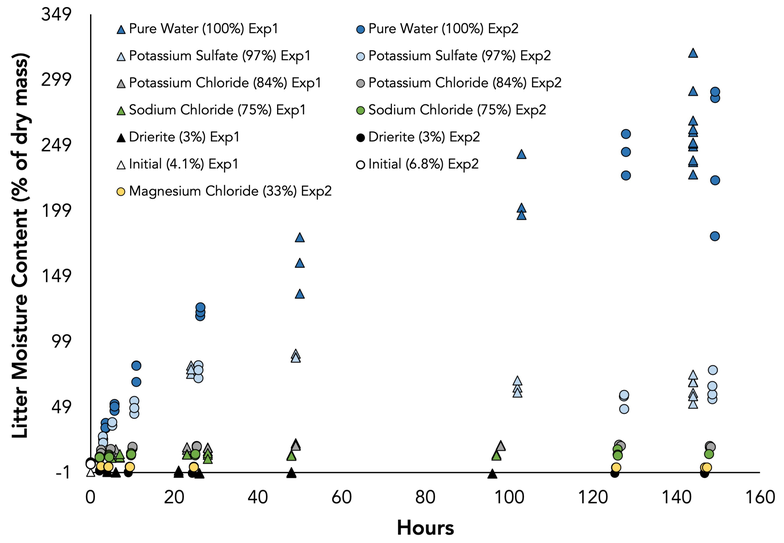


Figure 1. Litter moisture content as a percentage of litter dry mass over time.

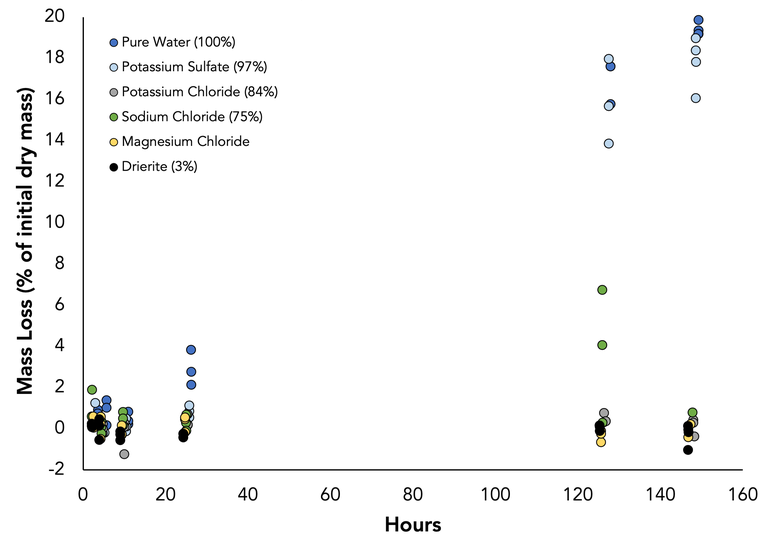


Figure 2. Litter mass loss as a percentage of initial litter dry mass over time.

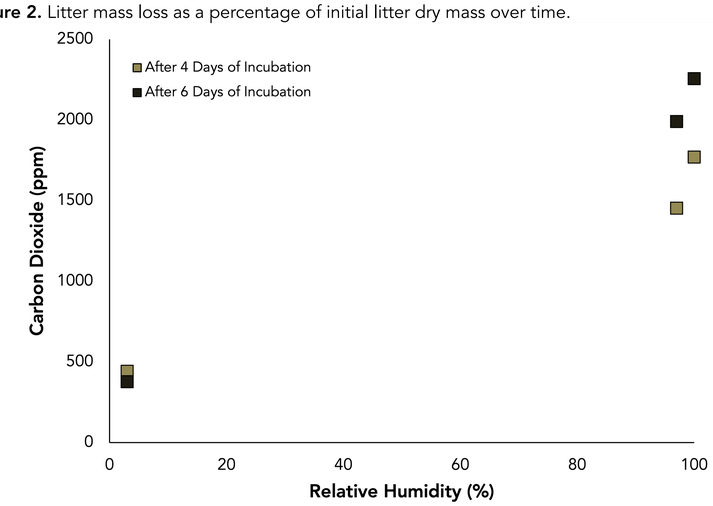


Figure 3. Carbon dioxide (CO_2) concentrations measured as a proxy for microbial respiration for Drierite (3% RH), Potassium Sulfate (97% RH), and Pure Water (100% RH) treatments.

ONGOING RELATED WORK

Litter "wet up" and "dry down" likely occur at different rates across unique microsites (e.g., open spaces vs. under shrub canopies).

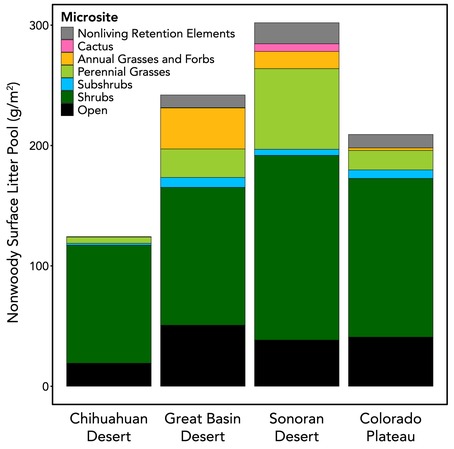




Figure 4. We are developing novel field techniques to quantify the size and distribution of litter pools in drylands, which will inform both regional and global models (Besser et al. *in prep*).





Figure 5. We deployed 2,592 litterbags this winter for periodic collection over the next three years to compare decomposition rates across microsites and sites.

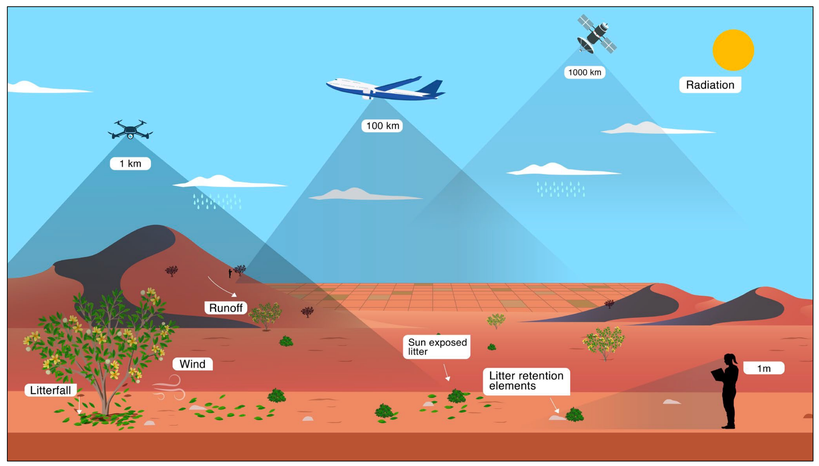


Figure 6. Our interdisciplinary team is integrating field, lab, and remote sensing data across broad spatial and temporal scales to inform hierarchical models and generate a predictive understanding of dryland plant litter decomposition (Throop et al. PNAS 2025).

Read our papers and find out more at: **drylands.asu.edu/DeADWeb**

THANK YOU

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