Fractionating Rainfall into Vegetative Interception and Soil Infiltration in Perennial Grassland

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Abstract

We determined the percentage of rainfall that is intercepted by the grass canopy and ground-level residue in a stand of 'WW-B.Dahl' Old World bluestem (*Bothriochloa bladhii*) (OWB). Measurements included soil water content changes, interception rates of vegetation, and evaporation rate from leaf blades and residue. Results will be used to develop a hydrologic sub-routine for use in a decision-support program for producers to predict the duration of grazing in relation to soil water supply.

Introduction

- Effective water infiltration into soil is critical for efficient plant response to precipitation.
- Precipitation which is intercepted by and evaporated from the grass canopy and litter residue does not infiltrate soil and should not be counted as an input in the water balance.
- Accurate corrections for rainfall input are required in simulation models of plant growth in subroutines that describe water availability.
- Rain interceptions by canopy and litter are often underestimated or ignored as when modeling growth of grasslands, so the soil infiltration rate has been assumed as 60% and greater[1,2].
- Amounts and proportions of rain interceptions are affected by 1) structure, mass, and moisture content of canopy and litter, and 2) intensity, duration and frequency of rainfall.
- The objective is to quantify the proportion of precipitation that is intercepted by the canopy and litter. Results will be used to build a rainfall-effectiveness sub-routine in the water logic of a grass growth model.

Figure 3. Diagram of each fraction of interception according to structural layer.

Materials and Methods

- Two cookie sheet trays (33.5 × 23.4 cm) were placed at the base of the OWB grass canopy. One sheet was empty for interception by the canopy, and the other filled with plant litter for water interception by the litter (Fig. 1).
- The trays were placed at six random locations in three replicate, ungrazed OWB paddocks, at the Texas Tech University, New Deal Research Station;
- The free water remaining in the trays was measured. Plant litter was collected, dried at 55°C, and weighed to calculate water content. Measurements are taken after each rainfall that occurred throughout one year.
- Time gaps between measurements and rain events were recorded. Post-event weather conditions, i.e. relative humidity, temperature and wind speed were recorded for each measurement.
- When there was no rain for longer than 30 d, rain was simulated by manually pouring over the trays.
- Green ground cover over the trays was estimated by Canopeo® (Fig. 2).
- Canopy % = ∑(mm intercepted by event)/∑(mm rain by event)*100%
  Litter % = ∑(mm intercepted by event)/∑(mm rain by event)*100%
  Infiltration% = 100 – Canopy% – Litter% (Fig. 3).

Figure 1. Rain trays after installed between OWB canopy

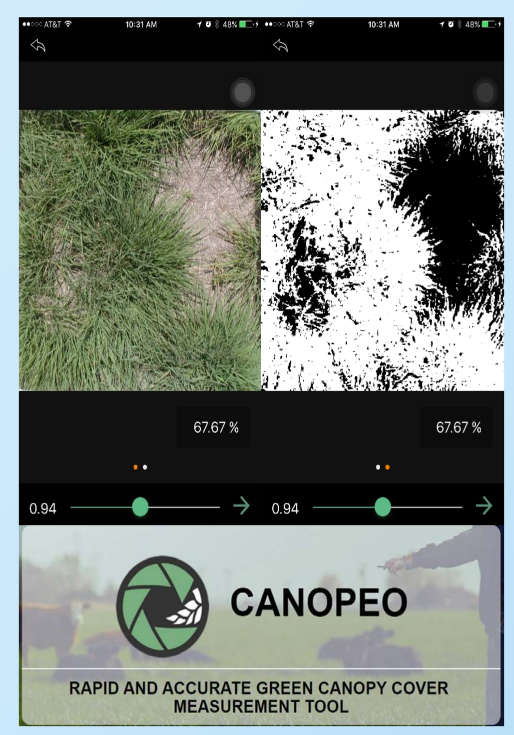

Figure 2. Canopeo® app operation interface for ground cover quantification.

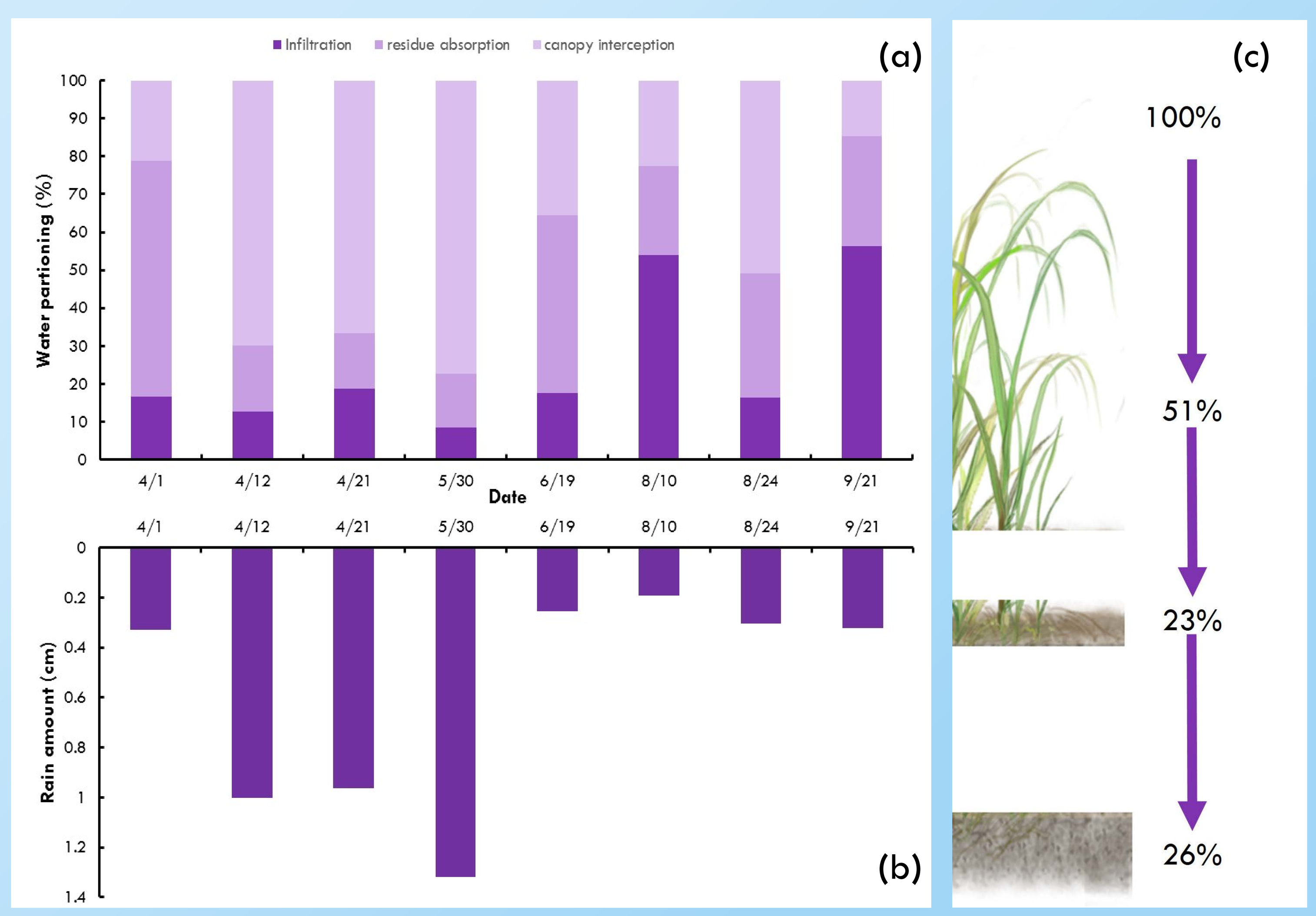

Figure 4. (a) Water partitioning throughout growing season, (b) rainfall event demonstration and (c) overall interception rate.

Results

- The partitioning of rain water among structural layers varied with rainfall event. In most events, canopy interception exceeded litter interception and soil infiltration (Fig. 4a). Soil infiltration on 8/10 and 9/21 was relatively high, corresponding to hand-watering events. Amounts of rainfall varied with event date (Fig. 4b). High-rain events generally occurred over relatively long durations. Overall, for the sum of the entire growing season, the canopy intercepted 51%, and the litter intercepted 23% (Fig. 4c). Only 26% of rain infiltrated the soil.
- There was no relationship between canopy interception and green ground cover (Fig. 5a); however, the rain amount was highly correlated to canopy interception (Fig. 5b). These results demonstrate the complexity of the partitioning of rain water among structural layers.

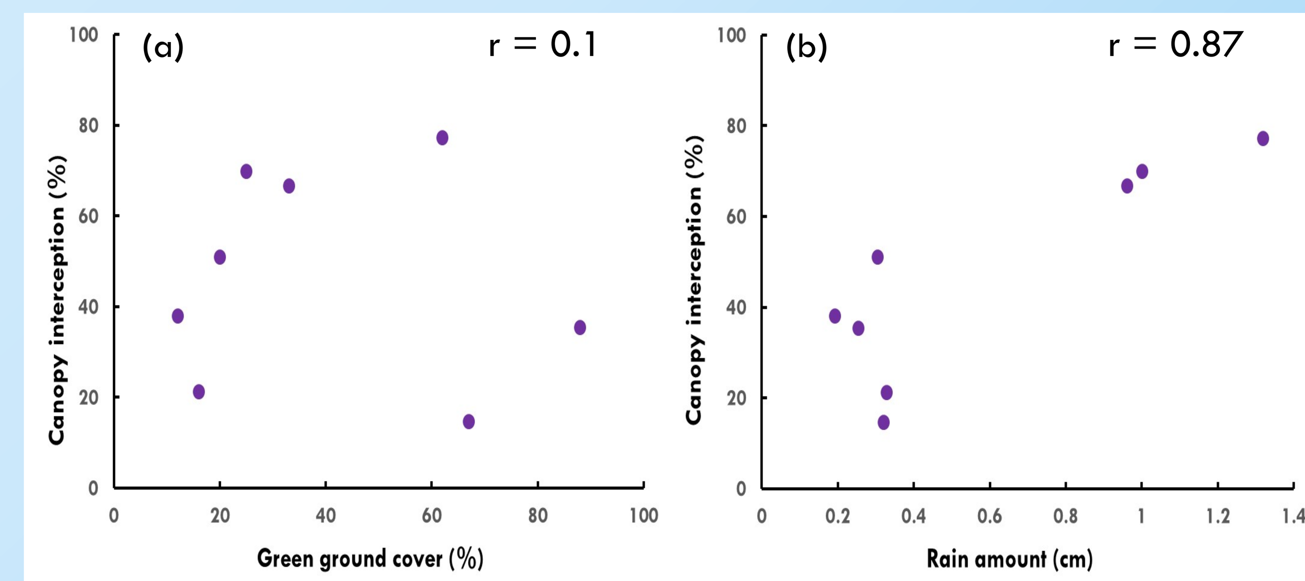

Figure 5. Canopy interception vs. (a) the green ground cover and (b) amount of rain water.

Conclusions and Future Research

- The canopy plus litter intercepted a large majority of the rain (74%) during the growing season. Soil infiltration (25%) was less than that recorded in annual crops.
- Canopy interception was not correlated with green ground cover, but was higher correlated with rainfall amount.
- In future studies, we will add the dormant season to complete the annual hydrologic cycle. We will also elucidate relationships between layer partitioning and weather data.

References

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