LITTER DECOMPOSITION RATES IN RANGELANDS AND THEIR IMPACT ON PLANT PHYSIOLOGICAL CHARACTERISTICS

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Abstract

The degradation of rangelands is widely recognised as a significant global issue. It is crucial to assess the resilience of rangeland ecosystems by evaluating decomposition rates and plant ecophysiological responses. This study used a Tea Bag Index (TBI) methodology to assess soil decomposition, as well as enzymology techniques to determine chlorophyll content. The findings showed that soil decomposition rates increased with distance from watering wells. However, a contrasting trend was observed in the change in chlorophyll a content of Artemisia diffusa. In conclusion, further investigation is required across the entire rangeland area.

Keywords: Decomposition, tea bag index, grazing, rangelands, chlorophyll.

Introduction

Livestock grazing is a widespread and significant form of land use across the globe. According to the FAO Statistical Pocketbook [1], approximately four-fifths of the world's agricultural land is dedicated to pasture. Extensive grazing by domestic animals is common in vast rangeland ecosystems worldwide. Rangelands adjacent to human settlements represent the largest area of grazing land in Central Asia. These ecosystems are of critical importance for providing fodder and other services [5]. Furthermore, these rangelands are the main source of income for the pastoralists who live in these regions [6]. However, unsustainable grazing practices have been shown

to affect the productivity of rangelands, vegetation composition, and soil structure in ecosystems worldwide.

Grazing is a significant land use in Uzbekistan, where rangelands occupy around 57% of the country's total area —approximately 25.5 million hectares [2]. Around 78% of these rangelands are found in arid and semi-arid plains that have been used for local animal husbandry for a long time. Soil content and plant ecophysiological responses play crucial roles in rangeland ecosystems. The study therefore, aimed to assess the rate of soil decomposition and changes in plant physiology in terms of pigment content along degradation gradients in the semi-desert rangelands of Karnabchul.

Material and Methods

The study was conducted in the Karnabchul desert of the Nurabad region during autumn 2023 and spring 2024. Two sites were selected for observation: one functioning well and the other abandoned (Fig. 1). The tea bag index was used to measure the rate of decomposition. Tea bags were installed at each site in autumn 2023 to assess the rate of soil decomposition. The area was divided into two transects, each of which comprised three plots. Three tea bags were randomly placed within each plot. To ascertain the ecophysiological response of the dominant plant species within the study sites, green parts of Artemisia diffusa plants were collected from grazing zones for pigment content analysis. This was conducted using the 'Physiological Methods' tool from 'Methods in Enzymology' [4] by spectrophotometry. The laboratory work employed a 96% ethanol solution and visible light wavelengths of 664 nm, 644 nm, and 470 nm to determine pigment content. Additionally, traditional geobotanical methods were used to assess vegetation composition within the study sites.

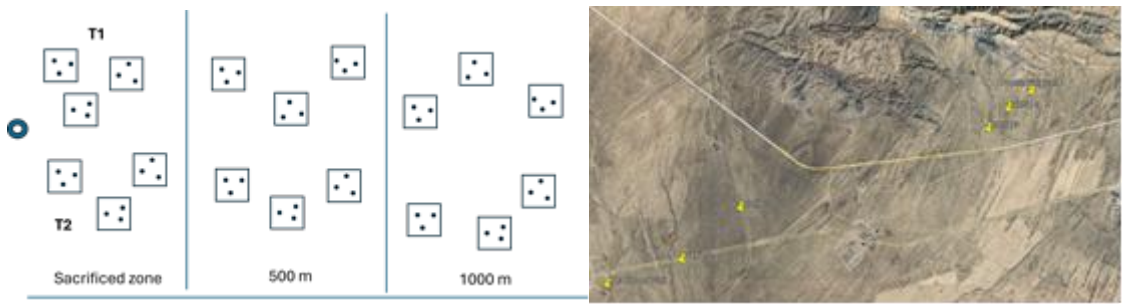


Figure 1. Grazing zones within study sites and experimental design.

Results

There were no significant differences in the mass loss of the tea bags in zones around functional (grazed) and abandoned (non-grazed) wells (Fig. 2). However, the bar chart shows that the decomposition rate of the tea bags gradually increased when moving away from the watering wells.

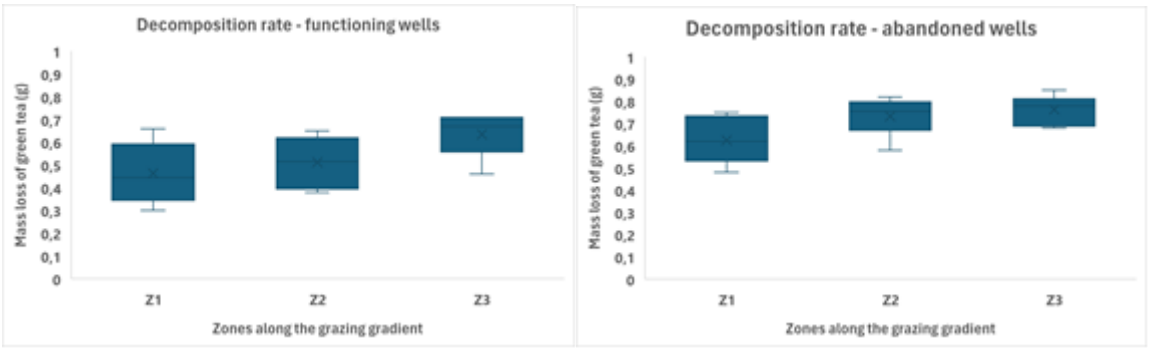


Figure 2. Decomposition rates along the zones in the study sites

The results indicated that grazing pressure plays a significant role in soil functionality and soil microbial activity. However, despite the fluctuations, the amount of chlorophyll a of *A. diffusa* species exhibited a reverse trend in both grazed and non-grazed sites, allowing for the comparison of decomposition rates along the zones (Fig. 3). The figure indicates that there is a correlation between grazing intensity gradients and chlorophyll a concentration changes, as shown in other investigations of Kushbokov [3] and Valiev [7].

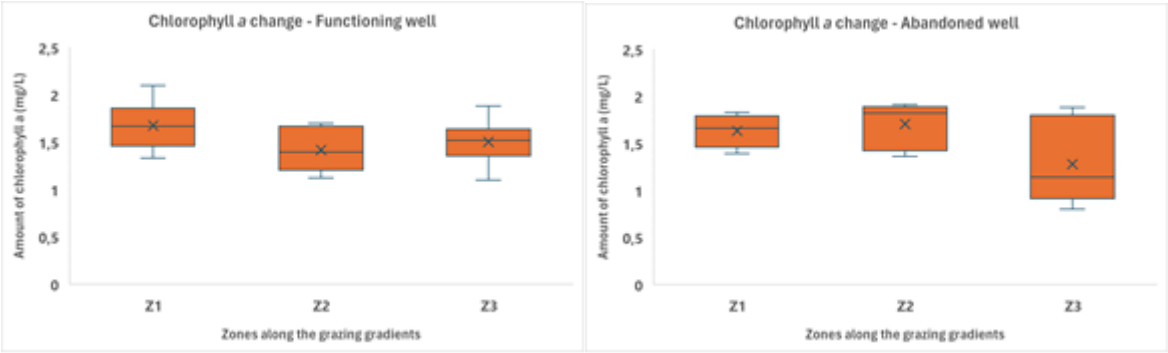


Figure 3. Chlorophyll *a* (*Artemisia diffusa*) changes along the zones in the study sites

In conclusion, the soil decomposition rate was observed to decline in the vicinity of the watering well, a consequence of the elevated grazing pressure exerted on the vegetation (resulting in a reduction in vegetative cover and an increase in bare ground). The increased chlorophyll content observed in overgrazed areas was hypothesised to represent a plant self-protection system, enabling survival and the production of new branches.

Literature

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