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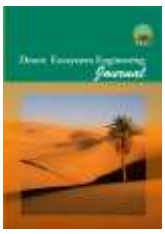

Investigation of the Effects of Mulch and Windbreak on *Sorghum* Growth and Weed Control Under Drought Stress

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Extended Abstract

Introduction

Sorghum is a highly productive forage crop, recognized for its adaptability to a wide range of soils and climatic conditions, its drought tolerance, and its suitability for use as both fresh and dry forage. Abiotic stresses, particularly drought, significantly limit agricultural productivity, especially in arid and semi-arid regions. To mitigate the effects of drought, strategies such as the use of drought-resistant species and mulching can be employed. Furthermore, the construction of windbreaks can help moderate the effects of strong winds. According to our background review, no research has been conducted on the simultaneous effects of mulch and windbreaks in reducing the negative impacts of drought stress on sorghum growth and weed control. The aim of this study is to investigate the effect of mulch and windbreaks on mitigating the negative effects of drought on sorghum, to classify different mulches based on their ability to alleviate stress-related damage, and to evaluate their role in weed control.

Materials and Methods

Seeds of the forage *sorghum* variety 'Speed Feed' were obtained from a reputable agricultural supplier. Sorghum was sown in early May 2025. Pre-planting mulch treatments—including black plastic, white plastic, straw, cardboard, and a control with no mulch—were applied. Drip irrigation was used throughout the experiment. Drought stress was applied at the six-leaf stage by maintaining soil moisture at three levels: 90%, 50%, and 25% of field capacity. To mitigate wind effects, sunflower windbreaks were planted one month before sorghum sowing and positioned perpendicular to the prevailing wind direction around the plots. Considering that the protective effect of grass windbreaks typically extends to 5–10 times their height, the distance between the sunflower row and the first sorghum plot was set at one times the final plant height in order to maintain the protective effect while minimizing shading and competition. Weed control was performed on three dates: 16 May 2025, 14 June 2025, and 9 July 2025. Forage sorghum was harvested at the soft-dough seed stage. Average plant height was measured in centimeters using a ruler. The fresh and dry weights of both shoots and roots were measured using a precision balance with an accuracy of 0.01 g. All data were analyzed using analysis of variance (ANOVA) in SPSS software, and means were compared using Duncan's multiple range test at a 5% probability level ($\alpha = 0.05$).

Result

Mulch application, particularly white and black plastic mulch, significantly reduced weed density. Under severe

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drought stress conditions and in the absence of windbreaks, white plastic mulch reduced weed counts by 99.5%, 96.5%, and 98.68% on the three sampling dates, respectively, compared to the no-mulch control. Plastic mulches also produced the greatest reduction in weed biomass across all sampling dates. Plant height was likewise influenced by mulch type. Under severe drought stress and without windbreaks, white and black plastic mulches increased sorghum height by 37% to 76% across the five growth stages relative to the unmulched control. In addition, mulch treatments enhanced sorghum biomass. Under severe drought and without windbreaks, white plastic mulch increased shoot fresh and dry weight by 69% and 72%, respectively, compared to the control. Cardboard mulch also increased root fresh and dry weight by 72.9% and 72%, respectively. Overall, mulch application effectively alleviated the negative effects of drought stress by reducing weed infestation and significantly increasing sorghum height, as well as the fresh and dry weight of both shoots and roots.

Discussion

Drought stress significantly reduced both weed density and biomass. This effect was further amplified by mulch application, which significantly reduced weed density and biomass across all sampling dates, likely due to a shading effect that limits weed establishment and growth. Plant height also decreased significantly with increasing drought stress, likely as a consequence of reduced meristematic cell production under limited water availability. However, mulch application mitigated this effect and significantly increased plant height. By conserving soil moisture and improving water availability to plants, mulch enhances physiological processes critical for growth, such as cell turgor and cell division. Furthermore, plant height was greater in plots protected by windbreaks than in unprotected plots. Similarly, drought stress significantly reduced the fresh and dry weight of both roots and shoots by limiting plant-available water. Mulch application counteracted this reduction by reducing evaporation from the soil surface, thereby maintaining a more favorable soil moisture regime for sustained plant growth

Keywords: Mulch, Plant Height, Weed, *Sorghum Bicolor*.