

Abstract

Background: Sorghum is an important source of fodder in the semi-arid areas of Kenya. However, its biomass yield has remained low due to the low soil moisture content which is associated with low rainfall. **Objective:** To evaluate the synergistic effects of combining rainwater harvesting practices on biomass yield and the morphometric traits of sorghum in semi-arid Kitui County. **Methodology:** The study was conducted in a randomized complete block design under rainfed conditions between March and August 2021 at the Research Farm of South Eastern Kenya University. It had twelve treatments, including three farming systems (conventional flat planting, ridge and furrow, and zai pits) with three soil mulching types (transparent plastic film mulch, black plastic film mulch, and grass mulch). The farming systems without mulching were used as control treatments. Data were subjected to analysis of variance and means were separated using Fisher's protected Least Significant Difference test at 0.05 %. **Results:** The zai pits with black plastic film mulch and flat planting with grass mulch had the highest and lowest moisture content of 68.65% and 52.5% respectively compared to flat planting. The highest biomass yield was observed in ridge-furrow with black plastic film mulch (3283.33kg ha⁻¹) and ridge–furrow with transparent plastic film mulch (3266.03) and was not significantly different. The lowest biomass yield was recorded in conventional flat planting and zai pits and was not significantly different. In all treatments, there was a significant increase ($p \leq 0.05$) in morphometric traits. **Implications:** The farming system and the type of soil mulching determined the increase of soil moisture content, biomass yield, and morphometric traits. **Conclusion:** Combining ridge-furrow and black plastic mulch is recommended to improve the biomass yield of sorghum in semi-arid Kitui County, and other areas with similar agroecological conditions.