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"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

Impact of maize plant residue on soil temperature dynamics in a dryland environment in Kenya

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Abstract

Soil temperatures are often high in dryland conditions. In cleared and tilled soils, increased temperatures contribute to accelerated rate of soil organic matter (SOM) decomposition, leading to increased CO_2 emissions and loss of soil fertility, and evaporation. Soil temperature behaviour depends on several dynamic parameters i.e. air temperature, precipitation, short wave radiation, soil moisture, and soil cover. Therefore, continuous measurements may be considered necessary to evaluate soil temperature dynamics under various treatments. Excluding growth of plants, the modification of soil thermal properties is reached through mulching, tillage practices and irrigation.

The recorded continuous soil and meteorological data were used to assess the impact of mulching on soil temperature in a dryland environment. Measurements were performed at the edge of a smallholder field in dry lowlands of Maktau, Kenya (3°25 33 S, 38°8 22, 1060 m asl). Soil temperature (Ts) and volumetric water content ( ) were measured continuously as vertical profiles (0–50 cm) during a two-year period (28/02/2016–26/02/2018). Meteorological parameters were recorded continuously on-site. The mulch was 1 cm thick maize stover corresponding to a mulching rate 5 t ha^{-1} (density 50 kg m^{-3}). The mulched period covered 28/02/2016–06/06/2016 (100 days). The mulch decomposed naturally. Initially, there was no vegetation on the soil surface and new vegetation growth was negligible during the experimental period.

Mulch reduced the diurnal fluctuation of measured Ts compared to bare soil. Daytime Ts peaks decreased below the mulch. The mulch also prevented nocturnal cooling of the soil. Ts decreasing effect was observed down to 30 cm. Reduced Ts fluctuation below mulch is suggested to be due to reduced shortwave radiation interception and increased heat capacity and conductance of soil due to conserved .

Plant residues find competing uses as forage and fuel among smallholder farmers in the study area, our results however, demonstrated that even a 1 cm thick maize stover layer clearly reduced the fluctuation of Ts down to 30 cm depth. Plant residue mulching can be recommended for dryland conditions similar to the studied site to reduce effects introduced by high Ts as well as conserve .

Keywords: Cooling effect, drought, mulch, smallholder

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