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# Effects of Coir Dust Mulch on Evapotranspiration of PH4 Maize in Coastal Region of Kenya

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Authors SMM and AMK wrote the protocol, designed, carried out the study in the field, collected the data and besides wrote the first draft of the manuscript. Authors AMK and WN assisted in statistical analysis, proof reading and literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

Although the Coastal region of Kenya is awash with abundance of moisture bearing South Easterly monsoons, (and therefore tropical rainfall) from the adjacent vast Indian Ocean, heat stress, high velocity wind regimes are major factors limiting crop productivity in the region. Occurrence of these abiotic factors tend to occasion cloud free conditions, high atmospheric demand and vapor pressure deficit that results in increased soil moisture deficit, which more often coincides with critical stages of maize growth resulting in poor maize yields. A 2x3 randomized complete block design experiment was set in 2007 and 2008 seasons at Pwani university farm using PH4 maize variety and coir dust mulch treatments at two levels, with and without mulch, to evaluate effects of coir dust mulch in ameliorating the effects of high temperatures and high velocity wind regimes on soil moisture status. The results showed that PH4 maize evapotranspired at an average rate of

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157.5 mm and 151.3 mm per phasic growth stage in non-mulched and coir mulched maize crops, respectively during the relatively wetter season I; and by 156.3 mm and 151.0 mm in non-mulched and coir mulched maize crops, respectively during the relatively drier season II. Coir mulching reduced the average rates of water use per phasic growth stage by 3.9% and 3.4% during the relatively wetter and drier seasons I and II, respectively. The results showed that during the relatively wetter season I, between 534-549.6 mm of soil moisture had to be expended as basal evaporation before any tangible dry matter yields could be obtained, while during the relatively drier season, 167.7-190.1 mm had to be expended. This basal evaporation values represented 48.2% and 17.0% of long rain's total precipitation during seasons' I and II, respectively, indicating that much of the received precipitation was not effectively used for grain production, but mainly lost as non-productive component of seasonal evapotranspiration. The results also indicated coir mulching resulted in decreased seasonal evapotranspiration but significantly increased conserved 100 cm-profile soil moisture early in the season, when compared to non-mulched control treatments. This conserved moisture was available later in the season for increased dry matter and grain yields. Coir mulching increased WUE by 8.4%. The study showed that adoption of a simple agronomic practice of applying a 10 cm thick layer of coir dust mulch could increase maize productivity by 10.4% and help improve livelihoods of people in Coastal region.

*Keywords: Coir mulch; evapotranspiration; Pwani hybrid; maize yields; coastal Kenya.*

## 1. INTRODUCTION

The Coastal region of Kenya is known to have enormous agricultural arable land potential due to its proximity to the Western Indian Ocean, with the coastal strip receiving an annual average rainfall of about 1100 mm (Fig. 1). However, due to its location in lowland tropics, the region experiences high ambient temperatures and high velocity wind regimes, in particular, the East African low level jet winds, locally known as the June winds that reduce the effective rainfall through excessive evapotranspiration [1]. These June winds tend to re-visit the region annually and their occurrence more often tends to coincide with critical stages of maize growth, namely, floral to grain-set/filling stages, resulting in poor yields. This has rendered the region to be perennially food deficit, and therefore highly dependent on food relief.

Occurrence of June winds is known to result in subsidence that causes reduced rainfall probability, cloud free conditions and increased evaporative demand, which consequently results in drastic decline in profile soil moisture and increased soil moisture deficit especially during critical stages of maize growth [2]. Occurrence of moisture deficit during critical stages results in poor pollen grain formation, poor stigma receptivity to pollen grains, delayed silk formation and asynchrony, resulting in poor grain set [3].

Heat stress is known to be a major limiting factor to plant productivity [4]. The region's high ambient temperatures coupled with cloud free conditions results in increased atmospheric demand and high vapor pressure deficit (VPD) that results in high transpiration rates which cannot be met by plant transpiration pull [5]. This ultimately results in reduced rates of transpiration and therefore increased leaf temperatures which lead to stomatal closure and therefore reduced $CO_2$ assimilation. This in turn results in midday photosynthetic decline and therefore low yields [4].

Increased soil temperatures are known to result in increased rates of evaporation from the soil surface which limits available soil moisture for plant growth. Occurrence of June winds increases turbulence and further enhances loss of soil moisture through evaporation. This study was therefore conceived to evaluate the effects of coir dust mulch on evapotranspiration and yields of PH4 maize in coastal region of Kenya.

## 2. MATERIALS AND METHODS

### 2.1 The Site

A field experiment was set up at Pwani University Crop Science farm located 39.85° E and 3.62°S in Kilifi County during the 2007 and 2008 long rain seasons (Fig. 1). The field was under natural fallow for two years. The experimental period for each year ranged from, 26$^{th}$ April to 3$^{rd}$ August. Average maximum and minimum temperatures ranged 28-30°C, and 20-23°C respectively, while annual rainfall averaged 1100 mm. Soils were mainly sandy loam with pockets of clay loam, with an average pH of 5.5, but poor in organic matter [6,7,8].