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Impact of Mixed and Alley Cropping on Grain Yield and Water Use of Maize

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Abstract

Mixed and alley cropping agro-forestry system have greater potential than other systems to increase the production and to control erosion on sloppy lands under tropical conditions. But the viability of such systems depends on their efficiency under limited soil conditions, which in turn makes them acceptable among the farming community. This study was conducted to investigate the effect of hedgerows on water availability in a maize-chili intercropping system on sloppy land. In 2009, the experiment was established on the Queen Sirikit Farm, Ratchaburi province, West Thailand as RCBD with three replicates. The treatments were T1: maize (*Zea mays*) monocrop, tillage, fertiliser; T2: maize intercropped with chilies (*Capsicum frutescens*), tillage, fertiliser; T3: T2 with minimum tillage, fertiliser, relay cropped with *Canavalia ensiformis*, and T4: T3 with *Leucaena leucocephala* hedgerows. The amount of fertiliser applied was 62, 11, 36 NPK kg ha⁻¹. Hedgerows were planted at three positions along the slope: top, middle and lower slope. Hedges were pruned regularly to reduce shading of maize rows close to it. Carbon isotopic discrimination ($\delta^{13}\text{C}$) was monitored in maize leaf and grain samples at 100 days after planting and at harvest, respectively. Volumetric water contents (VWC) were measured with time domain reflectometry (TDR) at 0.25–0.45 m soil depth. The VWC varied from 10–30% in dry to moist conditions. Soil moisture trends and $\delta^{13}\text{C}$ indicated greater water use by the plants growing in mixed cropping with fertiliser. The average row grain yield showed non-significant differences among treatments in the years 2010 and 2011 but T2 showed the highest yield per row followed by T4. Hedgerow treatments had reduced soil loss ($\leq 50\%$) and runoff ($\leq 30\%$) and increased soil moisture compared to non-leucaena treatments. Chili intercropping showed a positive yield impact on maize rows after the chili area by increasing the row grain yield while hedgerows negatively affected the maize row yield close to the hedge, more prominent in rows just after the hedge. The conservation technique was found effective in improving soil moisture during the crop growth period and intercropping was also found beneficial in raising row yields of maize.

Keywords: Alley cropping, chili, maize, mixed cropping, soil conservation, stable isotope discrimination, Thailand, water use