RESOURCES COMPETITION AND PRODUCTIVITY OF ANNUAL CROPS UNDER DIFFERENT HEDGEROW TREE SPECIES IN SLOPING AGRICULTURAL LAND TECHNOLOGY

By

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ABSTRACT

Continuous cultivation of annual crops on sloping lands in the Central highlands of Sri Lanka has led to significant soil erosion and loss of fertility. Contour hedgerow intercropping (HI), which incorporates tree hedges along contours, among the agricultural crops, has been recommended as a sustainable land management system for the above lands. The broad objective of this research study was to determine the positive and negative aspects of tree crop interactions that exist in the HI systems. Three experiments were conducted to identify the fertility and competition effects of hedgerow species on annual crops.

The first experiment was conducted to partition the overall tree-crop competition in to above (i.e. shoot) and below-ground (i.e. root) components in HI systems involving six tree species (*Calliandra calothyrsus*, *Desmodium ransonii*, *Flemingia macrophylla*, *Gliricidia sepium*, *Cassia spectabilis* and *Tithonia diversifolia*) and mung bean (*Vigna radiata*) grown at Pallekelle in the Mid-Country Intermediate Zone (IM_3). Shoot and root competition was estimated separately by a trenching (TR) treatment. The total competition was estimated as the yield difference between the untrenched (NTR) HI and sole crop. Root competition was estimated as the yield difference between trenched (TR) and untrenched (NTR) HIs. Mung bean yield reductions due to shoot competition were greater than due to root competition in all HIs except *Gliricidia* where the two components were equal. Total and shoot competition was highest by *Cassia* and lowest by *Gliricidia*, whereas root competition was highest in *Calliandra* and lowest in *Cassia*. Tree roots of hedgerow intercrops exerted significant competition with the annual crop for absorption of nutrients and water. Out of the tree species tested, *Gliricidia* exerted the least competition for nutrients while *Tithonia* exerted the least competition for water.

The second experiment was conducted at Kundasale in the mid-country intermediate zone to quantify the response of monocropped mung bean to mulches (3.3 t ha^{-1}) from the different tree species used in the first experiment with and without inorganic fertilizer. Mulching by all species increased mung bean yields in both fertilized and unfertilized treatments. Without fertilizer, highest and lowest yields were achieved by mulches from *Cassia* and *Desmodium* respectively. Yields achieved by mulching were accentuated by fertilizer. Yield response to fertilizer was highest with mulches from *Cassia* and *Desmodium* and lowest with *Flemingia* and *Gliricidia.*

The third experiment was conducted on a sloping (35%) land at Peradeniya in the mid country wet zone to quantify the reduction of soil erosion and overall tree-crop interaction (TCI) by partitioning the fertility effect (F) and the competition effect (C) of *Gliricidia sepium* hedgerows on maize (*Zea mays*). The treatment structure consisted of two HIs with (H_m) and without (H_o) mulch and two sole maize crops with (C_m) and without (C_o) mulch. The highest maize yields were obtained in C_m whereas C_o and H_o had the lowest. The overall TCI was positive (26 to 112%) because F (85 to 94%) outweighed the C (-67 to +18). Soil erosion in HI (9.22 t ha^{-1} yr^{-1}) was lower than in sole maize (60.77 t ha^{-1} yr^{-1}). Around 71-73% of erosion occurred during the cropping period with substantial erosion during land preparation and crop establishment. Based on inter-treatment variation of nutrients, water and radiation, it is concluded that in the contour hedgerow intercropping systems the fertility effect of HI exceeded the competition effects.

The overall conclusion from the results of this research study is that contour hedgerow intercropping has the potential to sustain crop production, reduce soil erosion and ensure soil fertility provided sufficient care is taken in appropriate selection of tree species and ensuring that their prunings are applied to the soil as mulch.