A study of the potential of hedgerow intercropping in semi-arid India using a two-way systematic design

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Abstract. The potential of hedgerow intercropping with Leucaena leucocephala was explored on vertic Inceptisols over 4 years at ICRISAT Center, Patancheru, India. The study was conducted using a systematic layout involving different alley widths ranging from 1.35 to 4.95 m and with varying distances between hedge and crops. The alleys were cropped with alternate rows of sorghum and pigeonpea. Hedges composed double Leucaena hedgerows 60 cm apart were periodically harvested for fodder. Sole crops of all components and a sorghum/pigeonpea intercrop were included in all four replications of the study.

Starting in the second year, Leucaena was progressively more competitive to annual crops, causing substantial yield reduction. Competition (primarily for moisture) was most severe in narrow alleys and was greatest on pigeonpea.

The growth of Leucaena was not sufficient to compensate for reduced crop yields. Land equivalent ratios (LERs) calculated on the basis of grain yield of crops and Leucaena fodder yields showed that hedgerow intercropping (HI) was advantageous over sole crops only during the first two years using wide alleys, but disadvantageous in the last two years. LERs calculated on the basis of total dry matter indicated only a small advantage for HI (13–17 percent) over sole crops in wider (> 4 m) alleys. Average returns per year from HI exceeded those of the most productive annual crop system (sorghum/pigeonpea intercropping) by 8 percent in 4.05 m alleys, and by 16 percent in 4.95 m alleys. Fodder production during the dry season was 40 percent of the annual total in these alley widths. Thus hedgerow intercropping at 4–5 m alley width is not very attractive for farmers in semi-arid India, which has 600–700 mm of annual rainfall. There is a need to examine the potential of HI in wider alleys. The merits and limitations of the systematic design are discussed.

Introduction

Agroforestry systems are at least as complex as intercropping with annual crops. While some of the research methods employed in intercropping have relevance to agroforestry research, special field layouts and evaluation
methods are required for the latter to attend to specific problems associated with perennial species. To develop any agroforestry system, one should work out the proportion of the perennials (number of trees), the proportion of the annual crop, and the spatial arrangement or the proximity at which both components can be planted. Quantification of tree/crop interface is the key to the understanding of competition between species and to the success of an agroforestry system [4]. Systematic designs have been in use in intercropping and horticultural crops for quantifying the yield-plant population/spacing relationships [1, 3, 8, 10]. Some of the designs can be extended for the study of agroforestry systems [5]. In view of the large number of factors to be studied in these systems, the number of combinations can become too unwieldy to evaluate in conventional designs. Systematic designs despite their limitations have been proposed for agroforestry research because they minimize the requirement for field and experimental resources.

The potential of hedgerow intercropping (also known as alley cropping) for sustained crop yields by incorporating the prunings from hedges of perennials has been demonstrated in humid tropics [7]. This technology is now being studied extensively throughout tropics, though studies in semi-arid climates are limited. In the Indian semi-arid tropics green fodder is scarce during the 7 to 9 months of dry period. Inclusion of multipurpose perennials such as *Leucaena, Gliricidia*, and *Sesbania* sp. in the annual crop systems might help alleviate the fodder scarcity. During the dry season these perennials might also explore the residual moisture and nutrients beyond the reach of annual crops and produce extra dry matter. However the removal of prunings for fodder will deprive much of the potential benefit for soil fertility improvement. Since food crops are important for the subsistence farmers, any new agroforestry system will only be acceptable to them only if annual crop yields are not unduly affected by the perennial species.

Initial studies on alley cropping in the Indian semi-arid tropics have given conflicting results on its potential [9]. Most studies have used *Leucaena leucocephala* because of its good coppicing ability and high fodder value [2]. Agroforestry experiments were initiated at ICRI SAT Center, Patancheru, India in 1984 to provide quantitative information on the productivity and resource use in hedgerow intercropping systems [6].

This paper describes an experimental field layout, designed particularly for studying hedgerow intercropping using *Leucaena*. We also discuss the potential of the system based on agronomic and economic results of the study for over four years.