

Innovative Maize-legume Intercropping Results in Above- and Below-ground Competitive Advantages for Understorey Legumes

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Abstract

Maize-bean intercropping (*Zea mays* with *Phaseolus vulgaris*) offers advantages to smallholder farmers in terms of crop diversity and risk avoidance, but continued reliance upon this practice has resulted in poor yields and widespread pests and diseases of bean in the smallhold growing areas of western Kenya. We are attempting to modify intercropping in a manner that will allow for a legume maize-legume-rotation as a means of disrupting pest cycles and improving the opportunities for symbiotic nitrogen fixation. The system, known as MBILI, is based upon staggering every other maize row by 25 cm, and growing legumes in the resultant wider inter-row, holding constant population of maize (44,444 plants ha⁻¹) and legume (88,888 plants ha⁻¹). This adjustment allows for intercropping legumes other than bean, particularly green gram (*Vigna aureus*) and groundnut (*Arachis hypogaea*), both of which have higher light requirements and greater capacity for symbiotic N-fixation than beans. MBILI was compared to conventional intercropping during a series of on-farm experiments conducted over four growing seasons (2000 to 2002) in Western Kenya. MBILI resulted in greater Land Equivalency Ratios than conventional intercropping, 2.0 vs. 1.7 ($P < 0.001$), (2000 short rains, calculated from crop value). Combined results from the 2000 and 2001 short rains were KSh 48 752 crop⁻¹ ha⁻¹ for MBILI and KSh 28 661 crop⁻¹ ha⁻¹ for conventional intercropping, at the otherwise same management. MBILI with groundnut increased crop value during three growing seasons between 2000 and 2001 to KSh 62 072 crop⁻¹ ha⁻¹ compared to conventional maize-bean intercropping (KSh 41 810), again under the same pairwise management. Some of these benefits are attributable to 54% greater light penetration to the legume understorey observed with MBILI (+20 934 LUX averaged throughout the day), an obvious aboveground advantage. MBILI also resulted in greater Fertilizer Use Efficiency (FUE), particularly by maize, because side-dressing applications may be more strategically placed. FUE of maize was increased by 46% (+7 kg maize kg N and P⁻¹) when conventional and MBILI yields are compared (short rains 2000 and long rains 2002). Furthermore, unexpected benefits to MBILI were observed during cropping seasons experiencing mid- and late-season drought, where overall maize yield under MBILI was 25% greater (+ 370 kg ha⁻¹), suggesting advantageous root distribution (2000 and 2001 short rains). Clearly, the benefits from MBILI include more than readily "meets the eye".

Introduction

Smallholders in East Africa are undergoing a profound transition from cereal-based subsistence farming to mixed-enterprise, market-oriented agriculture. The most common

subsistence farming activity in the semiarid and subhumid climatic zones is maize-bean intercropping, a system that is intended to reduce household risks during poor growing