Improvement of land use efficiency and drought resistance with a maize-soybean intercropping system in Northern Mozambique

Subsistence maize production is the first priority for smallholder farmers in Northern Mozambique; however, soybean has been attracting increased attention as a new cash crop in recent years. Our study, therefore, examined the simultaneous growth of maize and soybean in an intercropping system. Intercropping systems are considered particularly suitable in areas with unreliable rainfall and little external inputs as it diversify environmental risks and increase resource-use efficiency among the component crops. However, there is little empirical data available in the region on maize-soybean intercropping.

The performance of the intercropping system was assessed with respect to the land equivalent ratio (LER) using different fertilizer management practices in three agricultural environments, from a hot and semi-arid climate to a cool and humid climate, in Northern Mozambique. LER is calculated as the sum of the relative yields of maize and soybean in the intercropping plots with respect to the monocropping plots. It is generally accepted that LER values above 1 indicate that an intercropping system offers superior land-use efficiency over a monocropping system.

Locally recommended cultivars of maize (cv. Matuba; early maturity) and soybean (TGX-1937-1F; intermediate maturity) were grown at planting densities of 6.25 hills m^{-2} (80 × 20 cm) and 12.5 hills m^{-2} (40 × 20 cm), respectively, in the monocropping system. In the intercropping system, a maize row was replaced by three soybean rows every other two rows, which correspond to the planting densities of maize and soybean at two thirds (=0.67) and a half (=0.50) of those in the monocropping system, respectively (2Maize:3Soybean strip allocation). Three weeks after sowing, urea was side-dressed along the maize rows for both monocropping and intercropping systems at three different rates (0, 30, and 60 kg N ha^{-1}). No additional fertilizer was applied to any soybean rows.

The experimental results are summarized as follows:

- Maize-soybean intercropping demonstrated consistent advantage in productivity over monocropping, with LER values above 1 irrespective of N application rates to maize or experimental sites. LER values were particularly high in Nampula where a long dry spell occurred during the seed-filling stage of soybean (Table 1).
- The high LER values were partly attributed to more vigorous maize growth in intercropping than in monocropping, providing relative yields of 75-86% with two thirds of planting densities across fertilizer treatment and experimental sites (Table 1).
- When exposed to a dry spell, intercropped soybean (shaded by maize canopy) showed an apparent benefit in drought avoidance, as reflected by the slow depletion of soil water potential and the retention of the aboveground biomass relative to the monocropped soybean (Fig. 1).
- Under moist field conditions in Gurue and Lichinga, the LER values tended be smaller with increasing N application rates to maize because maize plants became more competitive and depressed the intercropped soybean yields to greater degrees.

Based on these results, it is concluded that maize-soybean intercropping can be recommended, allowing the introduction of soybean while ensuring subsistence maize production particularly in the low-N-input and drought-prone environment that prevails in the rainfed-upland areas of Northern Mozambique.

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Table 1. Maize and soybean yields in the monocropping system, relative grain yields of maize and soybean in the intercropping system, and LER values at different N application rates in three sites

Location (Alt.)	Maximum consecutive no-rain days	Fert.[a]	Monocrop Yield (t/ha)		Relative yield of intercropping		LER
			Maize	Soybean	Maize	Soybean	
Nampula (372m)	15	0N	1.61	0.57	75%	62%	1.37
		30N	1.78	-	82%	60%	1.41
		80N	2.13	-	86%	63%	1.49
Gurue (691m)	9	0N	1.75	1.87	81%	48%	1.29[ns.]
		30N	2.81	-	76%	39%	1.16
		80N	3.93	-	82%	33%	1.15
Lichinga (1397m)	6	0N	2.81	2.01	81%	46%	1.27
		30N	3.57	-	82%	45%	1.27
		80N	4.46	-	82%	33%	1.15[†]
ANOVA		Location (L)	***	***	ns.	***	**
**P<1%, ***P<0.1%		Fert. (F)	***	-	ns.	P=0.07	ns.
ns. not significant		L x F	**	-	ns.	ns.	ns.

LER values with underbars are significantly different from 1 at P<5% with one-sample t-test (n=4). † P=0.061, ns.P=0.11.

a: 0N, 30N, and 80N indicate the plots applied with 0, 30 kg and 80 kg ha^{-1} of N as urea to the monocropped and intercropped maize rows at three weeks after sowing.

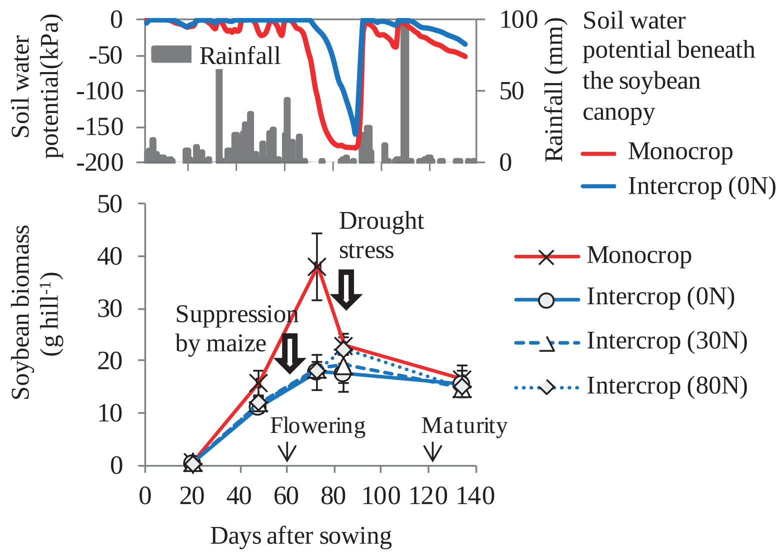

Fig.1. Changes in soil water potential beneath the soybean canopy at 20 cm deep (above figure) and in aboveground soybean biomass (below figure) in Nampula.

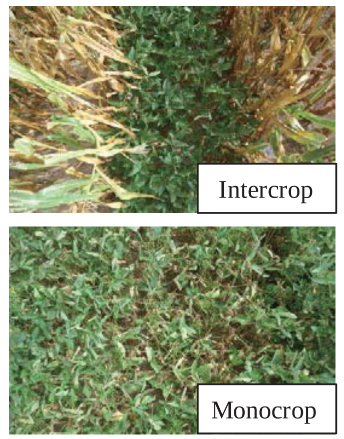

Fig. 2. Comparison of soybean growth after a long dry spell in Nampula.

Monocropped soybean was more severely affected by drought stress with substantial leaf abscission.