

On farm and on station ‘Best Bet’ maize-legume cropping systems evaluation under CA and Conventional practice in mid altitude sub humid of Western Ethiopia

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Key words: ‘Best Bet’ cropping systems, conservation agriculture, conventional practice

Introduction

Decline in soil fertility due to mono cropping is becoming a limiting factor for crop production in Ethiopia. Maize-legume rotation and intercropping systems in the context of conservation agriculture are believed to break or mitigate the continuous mono-cropping effect of maize in Western Ethiopia. With the objectives of evaluating and adapting sustainable smallholder maize-legume ‘Best Bet’ cropping systems technologies, a mother-baby trial approach was employed, involving twelve farmers in participatory on farm trials and one researcher managed experiment at the center between Bako Tibe and Gobu Sayo districts of Western Ethiopia. Based on biological performance, farmers’ preferences and cost benefit analysis, the first year evaluation was completed for best cropping systems technology selection. This results support, in general, the adoption of legume-maize cropping systems technologies in maize dominated farming system of Western Ethiopia where the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) project is implemented.

Material and Method

Three cropping systems (sole maize, sole soybean and maize-soybean intercrop) were evaluated under two land preparation treatments (conservation agriculture [CA] and conventional practice [CP]) in a complete randomized block design replicated three times as a “mother trial” at Bako Agricultural Research Station in western Ethiopia. A subset of these treatments viz., sole maize under CP, sole soybean under CP and CA, and maize-soybean intercrop under CA were evaluated as a baby trial in 10 m x 10 m plots of in 6 farmers’ fields. In addition, the same treatments but with haricot bean instead of soybean were evaluated in a separate set of experiments on 6 different farmers’ fields.

Chemical and physical soil characterization (data not presented) was done for four of the farmer fields and one on-station site to evaluate total N, extractable P, total organic carbon, bulk density and soil texture. It was clear from the analysis that the parameters varied across sites and at different soil depths.

Results and Discussion

Overall results of the first year mean data of the on-station trial indicated that grain and seed yield under conservation agriculture was not significantly different from conventional tillage practices. However, sole maize grain yield was significantly different in conservation agriculture at Bako Research Station (Table 1). The result might be due to higher water use efficiency (WUE) in sole maize under conservation agriculture ($6.56 \text{ kg ha}^{-1}\text{mm}^{-1}$) as compared to conventional practices ($5.59 \text{ kg ha}^{-1} \text{ mm}^{-1}$). Similar results were obtained at the Pawe site (SIMLESA Annual Report, 2011).

Averaged across the on-farm sites, haricot bean yield was higher under conventional tillage (1600 kg ha^{-1}) than under conservation agriculture (1100 kg ha^{-1}) while soybean produced the same yield (500 kg ha^{-1}) under both CA and conventional practice (data not presented). Furthermore, it was found that in haricot beans plant height, number of seeds per plant, pod length and aboveground biomass were negatively affected by conservation agriculture compared to conventional practice. In soybeans in the on-farm trials all of these parameters were higher under CA than under CP, except for plant height and aboveground biomass. Maize yielded more under conventional than conservation agriculture.

Cost benefit analysis for both maize-haricot bean and maize-soybean cropping systems is presented in Table 2a and 2b. The results indicate that the highest net benefit was obtained from the sole maize in CP (379 USD in maize-haricot bean and 309 USD in maize-soybean) followed by sole haricot bean in CP (276 USD) and maize in intercropping of maize-haricot bean under CA (239 USD). The low net benefit estimated from soybean and haricot bean was due to low seed yield as a result of delayed planting of the legumes.

On farm land equivalent ratio (LER) analysis indicated that 20 to 40% relative yield advantage was obtained by the intercrop over the sole cropping (data not presented). It is clear from Table 1 that the on station LER was greater in CP (1.97) than in CA (1.20). This in general shows that the productivity of intercropping of haricot bean/soybean with maize was greater in resource use efficiency as compared to sole cropping in both conservation agriculture and conventional practices.

In conclusion, there was no significant difference between CA and CP in grain/seed yield except in sole maize. Land equivalent ratio of maize soybean intercropping was higher in CP than in CA. Net profit analysis indicated that sole maize under CP was profitable than maize intercrop under CA in both maize-haricot bean and maize-soybean intercropping. Grain yield was reduced by intercropping only slightly in maize and greatly in soybean and haricot bean.

Reference

SIMLESA (Sustainable intensification of maize legume cropping systems for food security in Eastern and Southern Africa), 2011. Annual Review 08-11 March 2011, Nairobi Kenya.

Table 1: On-station mean performance of best bet cropping system evaluation

Treatment	Unit	Sole		Intercrop		LER _{total}
		Maize	Soybean	maize	soybean	
CA	t/ha	7.88	0.69	5.52	0.34	
CP	t/ha	5.37	0.74	6.08	0.62	
LSD (0.05)		2.5	ns	ns	ns	
LER _{CA}				0.70	0.50	1.20
LER _{CP}				1.13	0.84	1.97

Table 2a: On-farm Maize and haricot bean (HB) intercropping in CA and CP

Cost-benefit	Unit	Sole in CP		Sole in CA	Intercrop in CA	
		Maize	HB	HB	Maize	HB
Average yield	kg/ha	4,800	1,600	1,100	4,200	100
Gross income	USD/ha	564	564	388	494	35
Variable cost	USD/ha	185	288	273	255	28
Net profit	USD/ha	379	276	115	239	7

CP=conventional practices, CA=conservation agriculture, HB=haricot bean

Table 1b: On-farm Maize and Soybean (SB) intercropping in CA and CP

Cost-benefit	Unit	Sole in CP		Sole in CA	Intercrop in CA	
		Maize	SB	SB	Maize	SB
Average yield	kg/ha	4,200	500	500	3,700	100
Gross income	USD/ha	494	235	235	435	47
Variable cost	USD/ha	185	295	280	255	33
Net profit	USD/ha	309	-60	-45	180	14

CP=conventional practices, CA=conservation agriculture, SB=soybean