Improving productivity of maize-legume farming systems through Conservation Agriculture: Evidences and Lessons from SIMLESA Mozambique

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1. Introduction

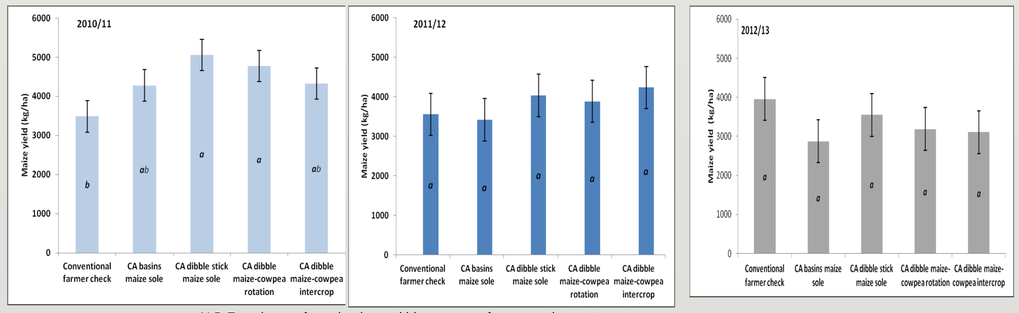
Mozambique experiences low average maize yields of around 0.8 t/ha due to low uptake of improved technologies (Figure 1).

For example the use improved maize varieties is estimated at 4 % with a requirement of 1,300 tonnes per annum. Fertilizer use is also lower than 5% while mechanization is less than 2%.

Since 2010 the Australian funded and CIMMYT managed '*Sustainable intensification of Maize Legume systems in Eastern and Southern Africa*' (SIMLESA) project, has been evaluating the merits of a variety of maize-legume systems under Conservation Agriculture in contrasting agro-ecologies of Central Mozambique.

This study evaluated soil moisture and maize productivity under the tested cropping systems in the last 3 seasons since 2010 and presents highlights of results from a few selected communities in Sussundenga district (Manica province), Gorongosa district (Sofala province) and sub-humid Angonia district (Tete province).

Figure 1. 95% of farmers use hand hoe, no fertilizer with only 4 % using improved varieties



N.B Error bars refer to l.s.d$_{(0.05)}$ within a season for separating treatment means

Figure 3. Mean maize grain yields measured over three cropping seasons 2010/11, 2011/12, and 2012/13 in Kabango community (+/- 1000 mm annual rainfall), Angonia district , Tete province, Mozambique.

2. Materials and Methods

Six treatments involving Conventional farmer practice, Conservation Agriculture techniques and different crop establishment techniques such as CA jab planter/ dibble stick and CA basins. One open pollinated maize variety (Tsangano) was used in sole, intercropping and rotation combinations with cowpea (IT-16). Other improved technologies included the application of inorganic fertilizers, row planting and use of the herbicide *glyphosate* for weed management. Trials with 6 farmers per community (district) with each farmer representing a replicate were established. Top soil moisture on some sites were measured periodically using a Time Domain Reflectometry (TDR) with probes measuring down to 20 cm depth while maize yields were measured at the end of each growing season for 3 years.

3. Results and Discussion

Soil moisture

Relative soil moisture content was significantly ($p<0.005$) higher and above 70% in all CA based treatments compared to conventional treatment (Figure 2). CA plots benefitted from extra moisture content due to residue cover in Angonia (Figure 2). Soil moisture in the ridges with the ridge and furrow conventional practice, which was left bare, was always lower in moisture status compared to CA.

The conventional ridge and furrow system was also prone to soil erosion after heavy rainfall especially when ridges run up and down the slope. So it was not surprising that the moisture content was significantly lower compared to CA treatments.

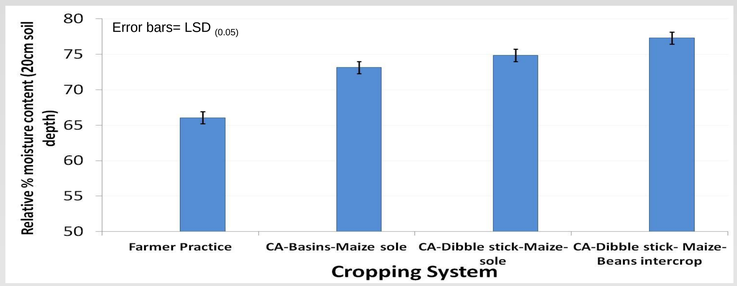


Figure 2. Soil moisture close to harvest time in Angonia, Mozambique (March 2012)

Yield performance

In Angonia yields from both Chiphole and Kabango communities (Figure 3) showed no significant differences ($p>0.05$) between the conventional farmer practice and CA practices with the magntude of differences being more pronounced in seasons with low rainfall and suppressed in seasons with high rainfall (+/- 1000 mm).

However a *combined analysis of variance across sites* for Gorongosa and Sussundenga showed significant yield increases between conventional farmer practice and the CA systems. Superior yield gains from CA systems were also observed in seasons with low rainfall (+/- 650 mm) suggesting moisture savings from CA, which were significantly higher in CA plots with residue cover, contributed to higher CA yields.

Improved maize yields were also realized from the CA maize-cowpea rotation systems in both Sussundenga and Gorongosa which resulted in mean yield increase of 32 % above the Conventional farmer practice (Table 1). CA Maize-legume rotation systems generally produced the highest yields across locations (see pictures below from SIMLESA sites).

Field evaluations also showed that maize-legume intercrops were often preferred by farmers due to the ability to generate two crops per given area despite lower maize yields from intercrops compared to rotations (Table 1).

Table 1. Mean maize yields over 3 seasons using different cropping systems across two districts (Sussundenga and Gorongosa) between 2010 and 2013 in central Mozambique

Cropping System	3yr mean maize yield (kg/ha)	% yield increase
Conventional flat manual hoeing	1487^{a}	0
CA basins maize/cowpea intercrop +glyphosate	1686^{ab}	13
CA jab planter maize sole+ glyphosate	1734^{bc}	17
CA basins maize sole + glyphosate	1812^{bc}	22
CA maize-cowpea rotation +glyphosate	1972^{c}	32

Note: $N=30$; $df=20$; $LSD_{(0.05)}=233kg/ha$

Note : Herbicide (glyphosate)used in all CA systems at 2.5 -3 l/ha

4. Conclusions

- Soil moisture results from Angonia suggest the possibility of intensified cropping by relay cropping with legumes to utilize the extra moisture in CA.
- Despite compromised maize yields from CA cereal-legume intercropping systems, farmers preferred them for their capacity to generate two crops from the same piece of land thereby intensifying productivity.
- Superiority of CA in very wet environments is diminished in high rainfall environments +/- 1000 mm /yr) as found in Angonia district while larger yields gains from CA were generated in lower rainfall environments (+/- 600 mm /yr) as in Sussundenga district. Yield differences between CA and farmer practice was therefore dependent on quality of season and management.
- Overall highest maize yields were derived from cereal-legume rotation systems attributed to nitrogen fixation from legumes and disease / pest suppression.
- Study results suggest the need for developing improved CA techniques capable of handling waterlogged conditions in very wet environments

5. Acknowledgments

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Ethiopia Kenya Malawi Mozambique Tanzania Australia