CIMMYT International Maize and Wheat Improvement Center | SIMLESA Sustainable Intensification of Maize - Legume Cropping Systems for Eastern and Southern Africa

Australian Government — Australian Centre for International Agricultural Research

Assessing the potential benefits of CA: Evidences from maize-legume systems of Sub-Humid Western Ethiopia

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INTRODUCTION

Among the food crops, maize is the main staple and legumes are an important dietary protein source for the rural poor in Ethiopia.

Seasonal climate variability causes wide swings in these crops yield.

Maize-legume cropping systems have shown considerable promises in stabilizing productivity and minimizing risks in rain fed conditions.

However, the crop production in high potential sub-humid ecologies of Ethiopia is constrained by many factors among which decline in soil fertility and maize mono-cropping in the are fundamental causes of low smallholder productivity.

Soil degradation and maize farming

Maize performance under mono-cropping and poor management

METHODOLOGY

Conservation agriculture (CA) is believed to contribute to sustainable farming and minimize environmental constraints by: (i) Minimizing soil disturbance with minimum tillage; (ii) keeping crop residues in the field for surface mulch; and (iii) diversifying cropping through rotation and intercropping maize and legumes.

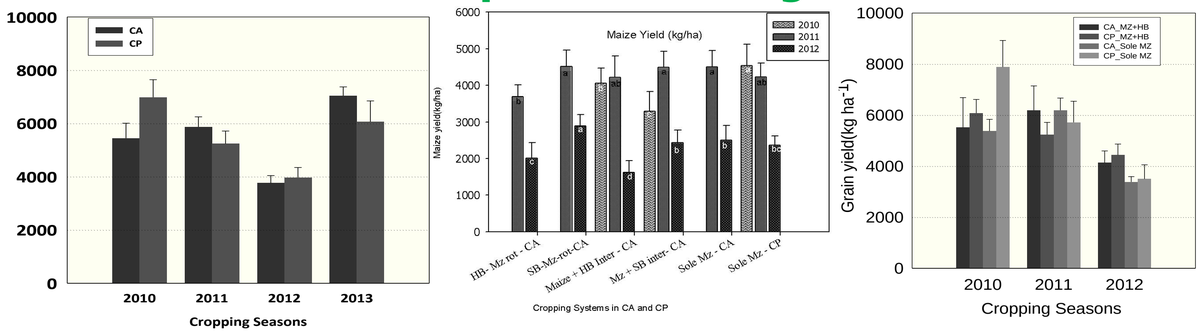
Since 2010, a combination of cropping systems under conventional and CA practices have been tested through on-station and on-farm exploratory trials around Bako (10 farmers for common bean and soybean_Maize cropping systems) in order to indentify the best-bet cropping and tillage systems.

RESULTS

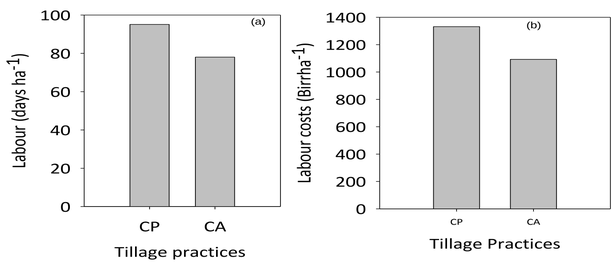
Evaluations of the on-station and on-farm exploratory trials to select best-bet practices using different criteria:

BASED ON YIELD PERFORMANCES

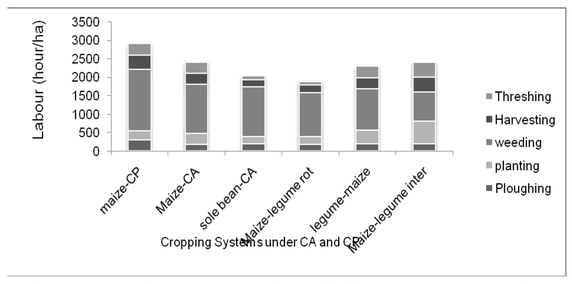
- Higher yields in Maize-Haricot bean intercropping, Maize-Soybean intercropping and Maize after Soybean for rotation
- CA practices resulted superior grain yields of maize to the farmers' conventional practices across experimental seasons
- Highest maize yield (4515kg/ha) when maize was planted after soybean under CA in 2011as compared to previous haricot bean



Comparisons among grain yields of maize due to the interaction of cropping systems and tillage practices across cropping seasons



Labor use for conventional tillage and conservation agriculture practices (a) and the corresponding labor costs of the tillage practices (b)



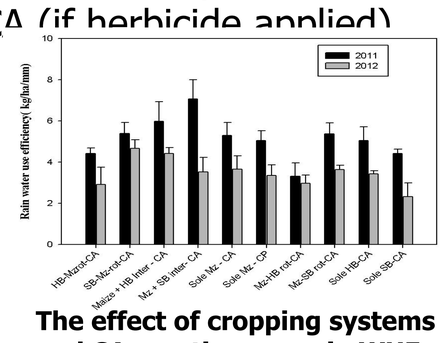
Labor requirements for different operation in maize-legume intensification with CA and CP practices

BASED ON LABOR PRODUCTIVITY

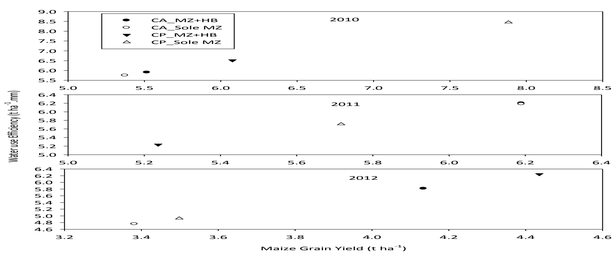
- On average, **95 days/ha** (birr 1331/ha) spent to produce maize and haricot bean under CP whereas **78 days/ha** (birr 1092/ha) required under CA ➔↓ **family labor**
- CP need more labor requirements for plowing as compared to CA
- CA reduced 32-41% total labor required for plowing in the CP
- CP for maize production required more labor for weeding as compared to CA (if herbicide applied)

BASED ON WATER USE EFFICIENCY (WUE)

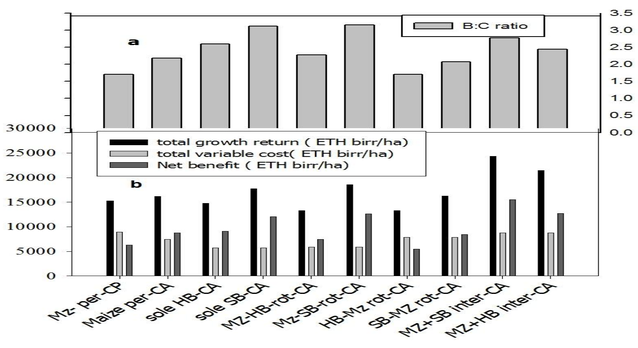
- Intercropping systems considerably increased WUE as compared to crop rotation or continuous production in CA or farmers practices
- During 2012 cropping season (below average rainfall season), haricot bean-maize intercropping gave higher yields
- Continuous production of maze in CA considerably showed more WUE as compared to farmers' practices



The effect of cropping systems and CA practices on rain WUE



WUE impacts on maize grain yield under maize haricot bean cropping systems across cropping seasons



Total variable cost, growth return, net benefit (b) and benefit: cost ratio (a) as affected by different cropping systems in CA practices

BASED ON ECONOMIC RETURN

- Highest growth??? return from maize-soybean intercropping under CA
- Highest total variable cost for Sole maize production under CP practices. Maximum net benefit when soybean and haricot bean intercropped in maize: 15545 and 12693 ETH birr/ha
- For sole bean production, 34-36% reduction of total variable cost as compared to maize one
- Highest B:C ratio(3.2) when soybean grown as sole in crop rotation or continuous under CA
- Minimum B:C ratio (1.7) from CP maize production
- Higher net return for maize production under CA than farmers' practices since cost incurred for animal traction reduced by more than 25%

CONCLUSIONS

- Maize-haricot bean (or soybean) intercropping and soybean/maize rotation under CA are more stable in low rainfall seasons, hence preferable to obtain higher productivity as compared to continuous maize mono-cropping
- Conventional practices require more labor for tilling and weeding as compared to CA practices
- Intercropping practices under CA reduced labour from 29% to 52%, in addition to high water use efficiency & reduction of crop failure risks
- Therefore, intercropping with either haricot bean and/or soybean and rotating it with soybean under conservation agriculture could be recommended to the high potential sub-humid maize and legume producing agro-ecology of western Ethiopia

ACKNOWLEDGEMENTS

This research was conducted with the support of the Australian government (**ACIAR**) through the 'Sustainable Intensification of Maize-Legume Cropping Systems for Eastern and Southern Africa (**SIMLESA**)' project coordinated by CIMMYT. The authors also thank all CIMMYT-Ethiopia and NARS staffs who contributed to the research. We are also grateful for all technical and field assistants of Bako Agricultural Research Center (BARC) who participated for implementation of the experiment and data collection.

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