Long-term productivity and sustainability of maize-soybean cropping systems through conservation agriculture

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Background

Since 2003, CIAT has maintained a long term trial in Western Kenya to study the impact of tillage, crop residue management, crop rotation and various levels of mineral fertilizer application on system productivity and sustainability. Maize and soybean were selected as test crops because maize is a dominant food crop in the region while soybean is a dual-purpose legume that has the potential to improve soil fertility.

Objectives of the trial

- To study the impact of reduced/zero tillage, crop residue retention and different crop rotations on system productivity, sustainability and soil health **long-term**;
- To develop optimal mineral fertilizer/liming recommendations for such systems.

Treatments

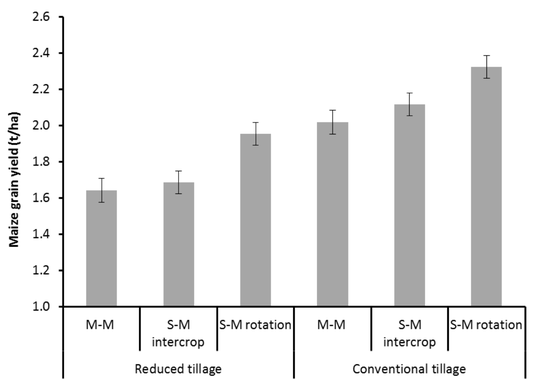
- Conservation agriculture vs. conventional agriculture
  - Reduced/Zero tillage against conventional tillage
  - Maize stover retention (2 t/ha) vs. removal
- Continuous maize, maize-soybean rotation and intercropping of maize with soybeans
- Different levels of Nitrogen (N) and/or phosphate (P) mineral fertilizer application
- Lime and micronutrient application

The trial has 44 treatments repeated 4 (some 8) times.

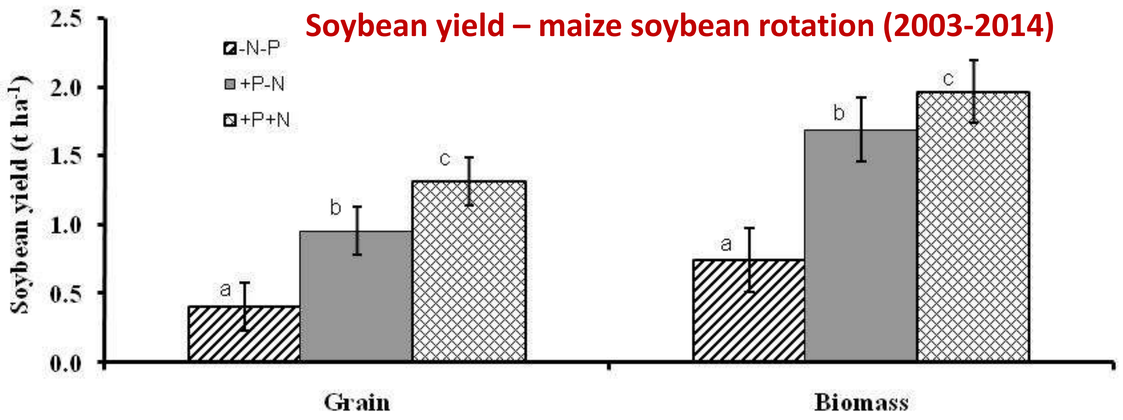
Selected Results

- Seasonal average maize grain yields were 3.2-4.1 t/ha under continuous maize, 3.0-3.9 t/ha in the soybean-maize rotation, and 1.8-2.8 t/ha in the soybean maize intercropping system.
- Soybean grain yields were 0.9-1.0 t/ha in the soybean-maize rotation and 0.52-0.60 t/ha in the intercropping system.
- Cropping rotation had significant effect on yield.

Cropping system performance



Soybean yield – maize soybean rotation (2003-2014)



- Performance of the zero-tillage/direct seeding system was as good as conventional systems only if residues were retained.
- Crop residues disappeared at fast rates due to termite activity.
- Nevertheless, reduced/zero tillage without residue application achieved lower yields.
- Both maize and soybean respond to N and P; soybean responds less to N.

Field preparation – reduced tillage on the right, conventional tillage on the left side

Crop residue retention

Soybean

Maize

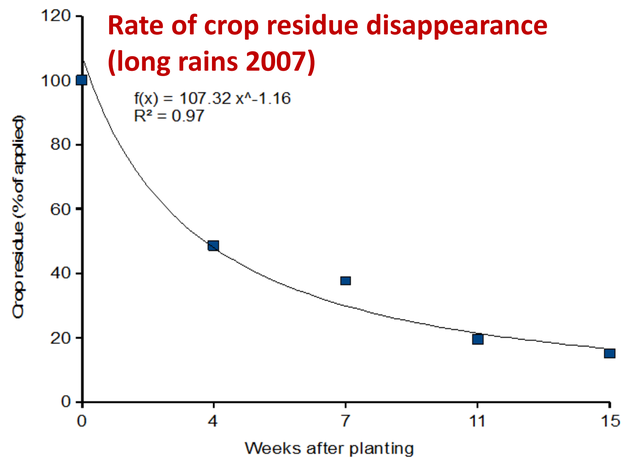
Surface residues consumed by termites

Long-term lessons

Reduced tillage and residue retention

- Reduced tillage with crop residue improves soil structure, which improves soil water infiltration and thus potentially reduces water stress.
- Residue retention also improves soil biology (microbial composition and richness).
- Yet, retaining residues is not attractive to mixed crop-livestock farmers due to the competition for livestock feed.

Rate of crop residue disappearance (long rains 2007)



Crop Rotation and Intercropping

- Intercropping maize and soybean has highest net benefits.
- Rotation of maize and soybean result in additional yield benefits relative to continuous maize.
- Soybean yield is the same in both conventional and reduced tillage.
- Maize planted following soybean has higher yield than continuous maize.

Conclusion

Combining technologies to maintain or improve soil fertility, such as conservation agriculture, improves and sustains long-term productivity of cereal-legume systems in Western Kenya.

Our partners and donors

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