Conservation Agriculture in Malawi:

Integrating agroforestry to enhance productivity and sustainability

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Introduction

The common method of land preparation among smallholders in Malawi **involves clearing and burning of weeds and debris with annual construction of ridges** 90cm apart, a practice that requires an enormous amount of hard manual labor.

There is increasing evidence that this practice contributes to runoff, erosion and general soil degradation, particularly under conditions of low input, continuous cultivation. Moving the soil accelerates oxidation of organic carbon and reduces carbon content. This exposes soils to raindrop action and erosion.

Tillage also disrupts natural aeration and the beneficial actions of soil micro-flora and fauna.

Although incorporation of crop residues is promoted and practiced by farmers in some parts of Malawi, results suggest that residues are better left on the soil surface where they intercept raindrops and protect the soil from the elements.

Conservation Agriculture

Results from research and extension around the world and in Southern Africa support the hypothesis that conservation agriculture can increase and stabilize crop yields, while dramatically reducing soil erosion and moisture loss. It has also been shown to be cheaper and less labor intensive than conventional annual land preparation. Achieving these benefits requires the adoption of certain management disciplines that demand a break in cultural norms.

The concept in Malawi combines ***minimal tillage with the management and retention of crop residues, control of weeds with herbicides*** (at least in the short term), ***modest use of*** *fertilizers*, and the integration of ***annual and perennial legumes*** to a) improve soil fertility, b) to control pests & diseases, c) to improve nutrition, and d) to increase returns to land and labor.

KEY FEATURES OF CONSERVATION AGRICULTURE

- Saves labor & permits diversification and expansion
- Allows for early planting to maximize yields
- Protects the soil against runoff & erosion
- Improves soil properties & retains soil moisture and nutrients
- Controls and suppresses weeds, pests and diseases
- Sequesters carbon & reduces CG emissions from burning
- Complements use of chemical fertilizers
- Intercropping of n-fixing leguminous shrubs (e.g., Tephrosia, pigeon peas) helps to break up hard pans and improves soil fertility

Net Results: Increases and stabilizes yields with reduced risk and threats from climate change

Objectives

TLC's mandate is to improve the livelihoods of rural communities with a focus on increasing food security, diversification, nutrition, and incomes within a context of sound land and water management. TLC Projects in Malawi, Tanzania, Zambia and Mozambique all share this goal with financial support from a wide range of donors.

Conservation agriculture is one of the interventions targeted to tackle the multiple challenges that smallholders face in Malawi. The program started in 2005 as a collaborative effort with CIMMYT and the Department of Agricultural Research in the Ministry of Agriculture and Food Security.

Purpose: The aim was to design a set of simple practices that would deliver fast and visible results at the farm level to attract widespread adoption. This task began with a thorough review of available literature and experience on reduced tillage, conservation farming, and other related practices.

Design

The collective experience from researchers and practitioners from within our own organizations, as well as from national research institutes, universities, international centers and others resulted in the design of farmer managed demonstration plots to be established with farmers across a wide range of ecologies. Technical support for these trials would be provided from national and regional researchers involved with managing replicated experiments on research stations.

This poster focuses on results generated from on farm research and demonstrations with farmers in Malawi spanning a period of 10 years with attention on the last 4.

TLC Projects were instrumental in supplying the human, financial and physical resources to implement the program in the field with farm communities and households very familiar with TLC. This provided the crucial starting point for launching the program on conservation agriculture.

Results: CA Demos with Farmers: 2005-2009

All plots are 0.1 ha in size treated with the same amount of fertilizer, crop variety and seed rate

Treatments

- **Control:** Standard farmer practice with land clearing, planting on ridges build manually 75cm apart and hand weeding

- **CA Maize Pure Stand:** Crop residues spread & retained on the surface; planting on the flat or old ridges without tillage. Glyphosate + Bullet applied pre-emergence

- **Maize + Legume Intercrop:** (Cowpea Ppea, Tephrosia, Mucuna). Crop residues spread & retained on the surface; planting on the flat or old ridges without tillage with direct sowing of intercrop. Glyphosate applied at planting

INPUTS (provided to farmers under signed loan agreements with a 40% down-payment)	US$	Per Ha Cost	
	Unit Cost	Qty	US$
Hybrid Maize Seed (kg)	**2.50**	**20**	**50**
Pigeon Peas (kg)	**1.80**	**1.2**	**2**
Herbicides			
Roundup (liters)	**12.50**	**1.67**	**21**
Bullet (liters)	**12.50**	**0.83**	**10**
Fertilizers *			
23:21:0:4 (50 kg)	**7.14**	**2.47**	**18**
UREA (50 kg)	**7.14**	**2.67**	**19**
Total Cost			**120**

*** Malawi subsidy program for smallholders**

Benefits of minimal tillage with retention of crop residues on the soil surface

Clearing & burning land with labor intensive ridging exposes soil to the elements and oxidizes carbon

Conservation agriculture saves labor, protects against runoff and erosion & conserves soil moisture and nutrients

Uniform stand of newly planted maize among crop residues after herbicide treatment showing weed-free conditions

Surface mulch and herbicides keep fields free of weeds, always a major limitation with hand weeding; with widespread adoption, the need for herbicides will decline by depleting the reservoir of weed seeds

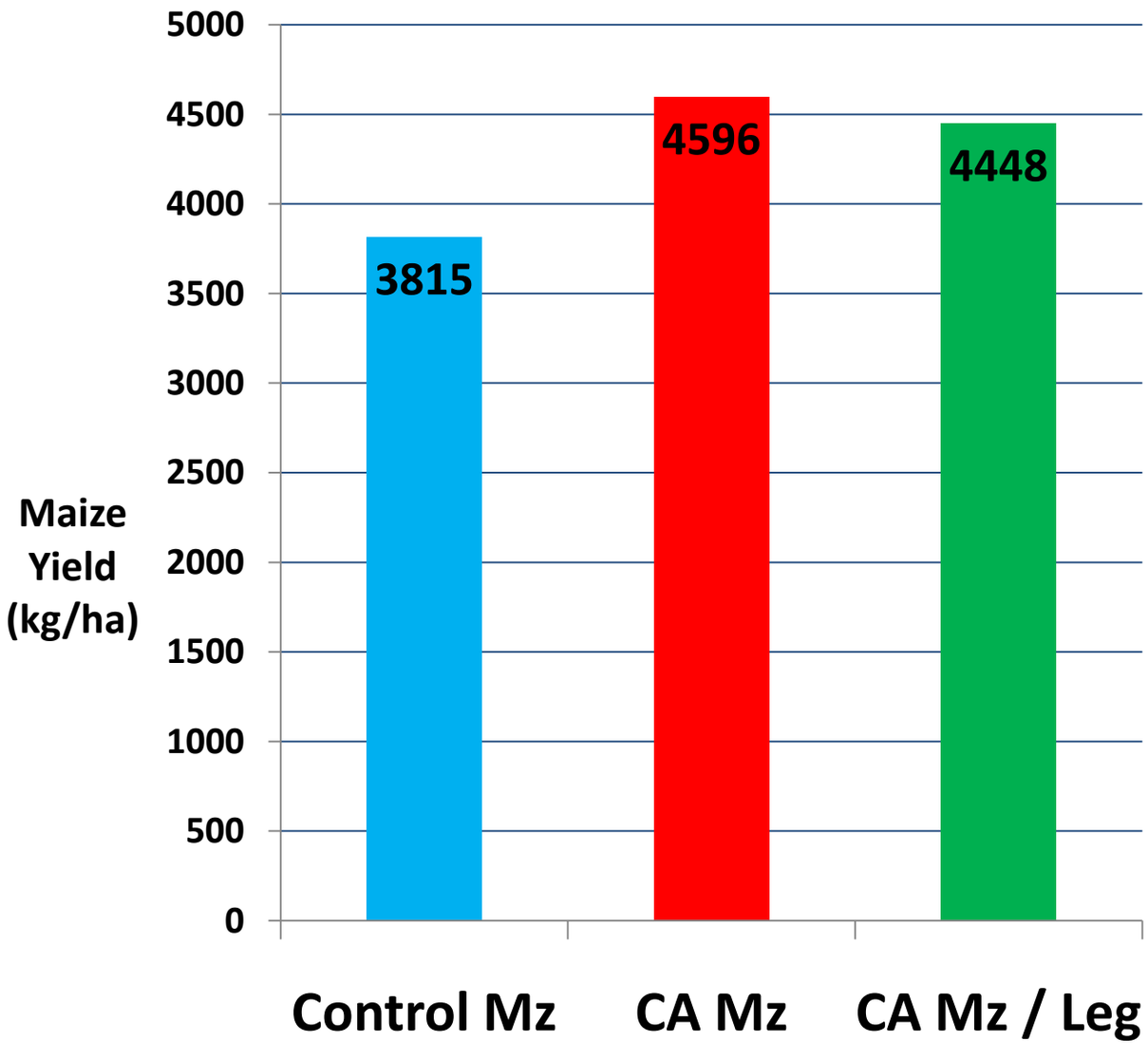
CA in practice with farmers

CA on the left vs. standard farmer practice on right

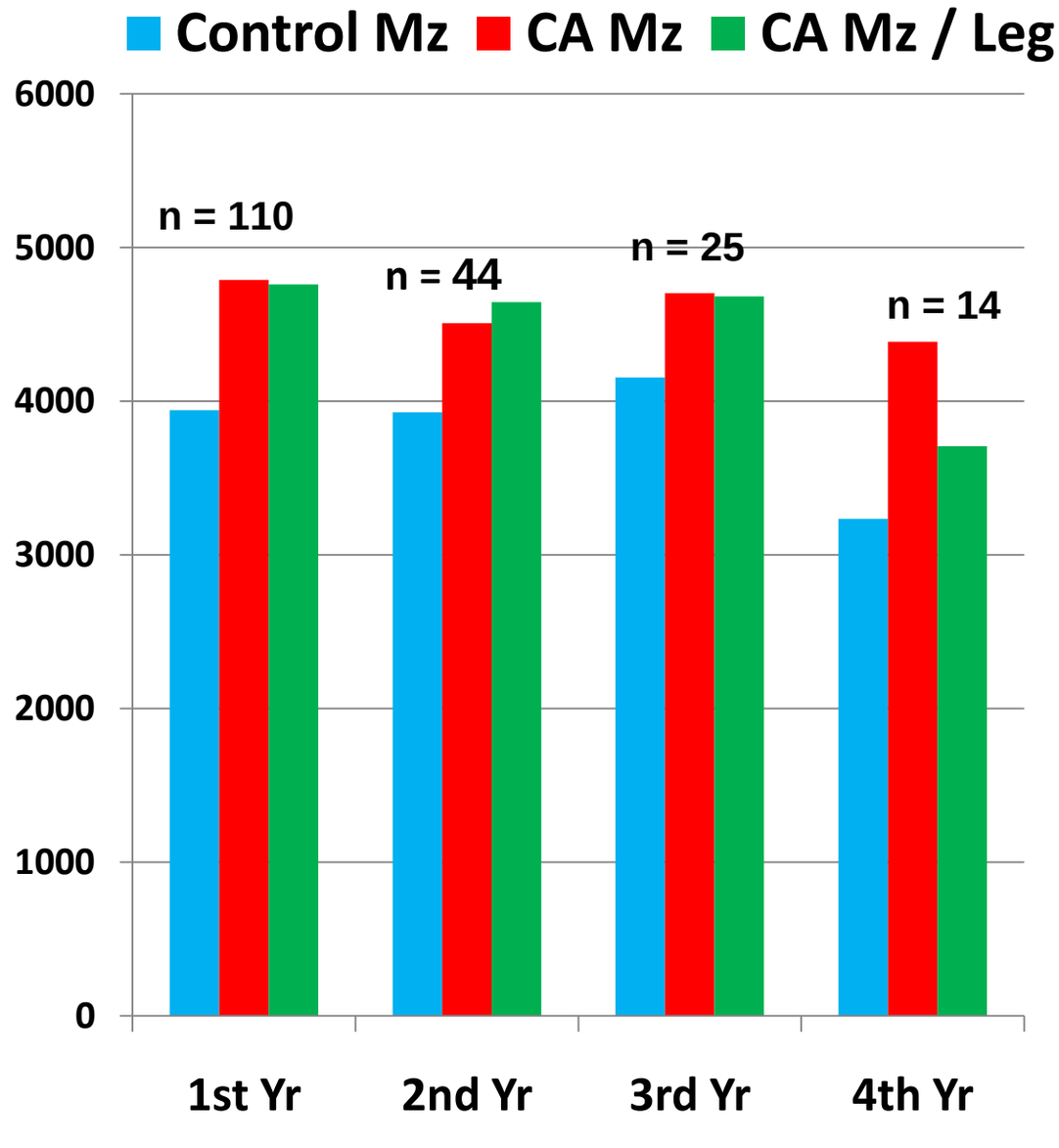
CA maize crop at maturity

Maize yields under CA are higher and more stable than the standard practice

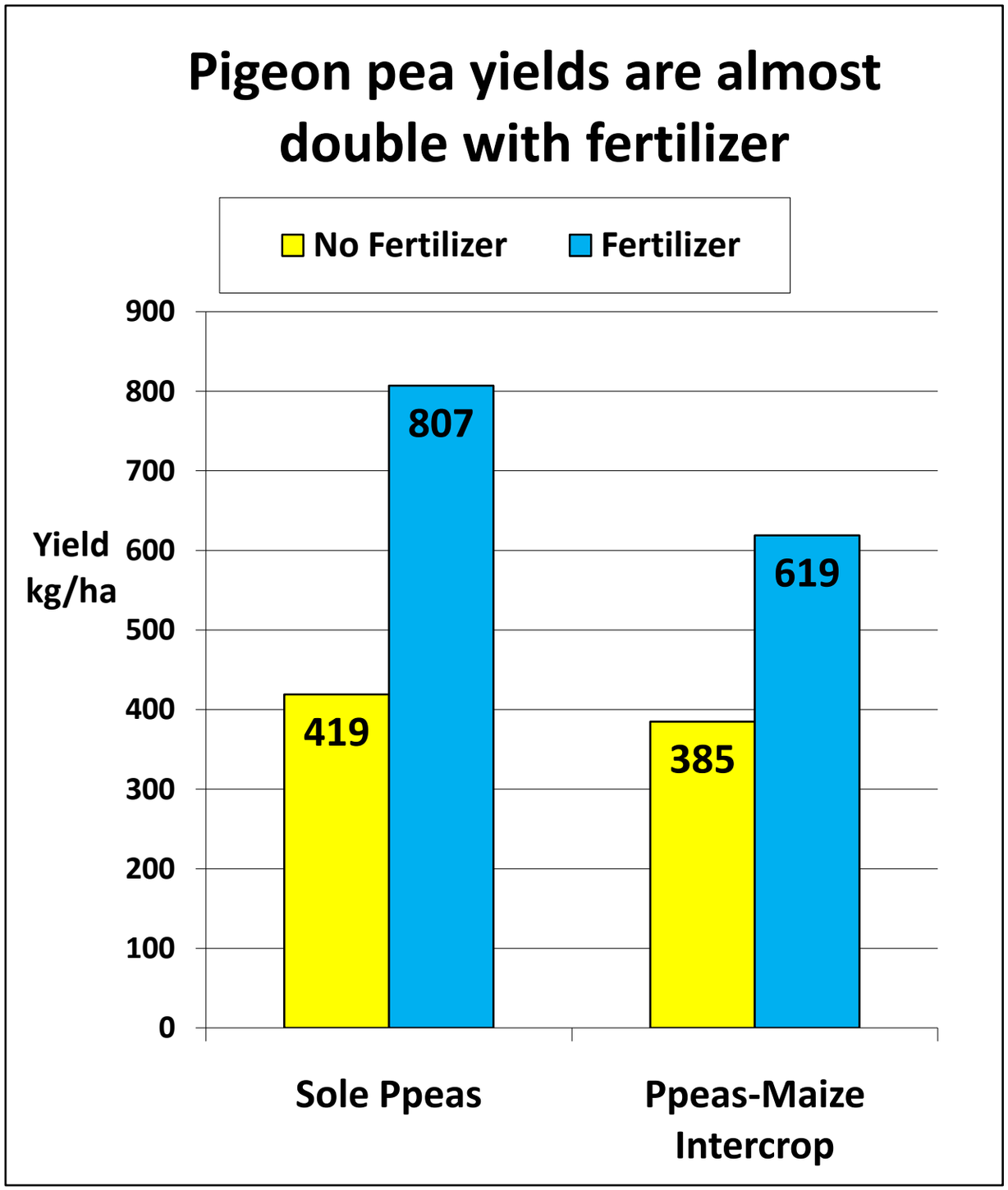
Mean yields from 193 farmers over 4 Years (2006 - 2009)



Trends in Maize Yields Over Time

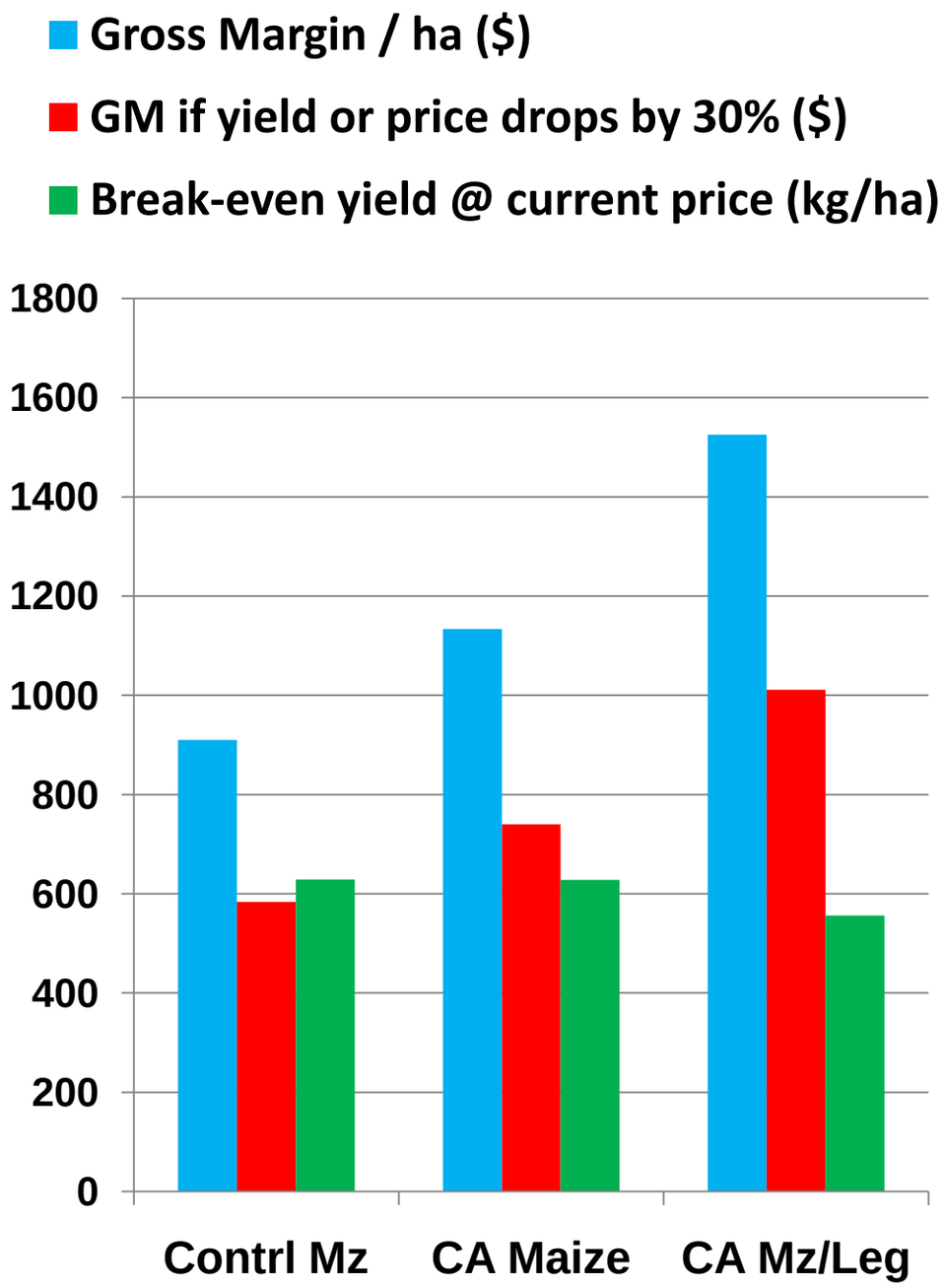


Legume rotations and intercrops improve soil fertility, reduce pests & disease, improve diets, and increase returns to land and labor



Beans in rotation with maize

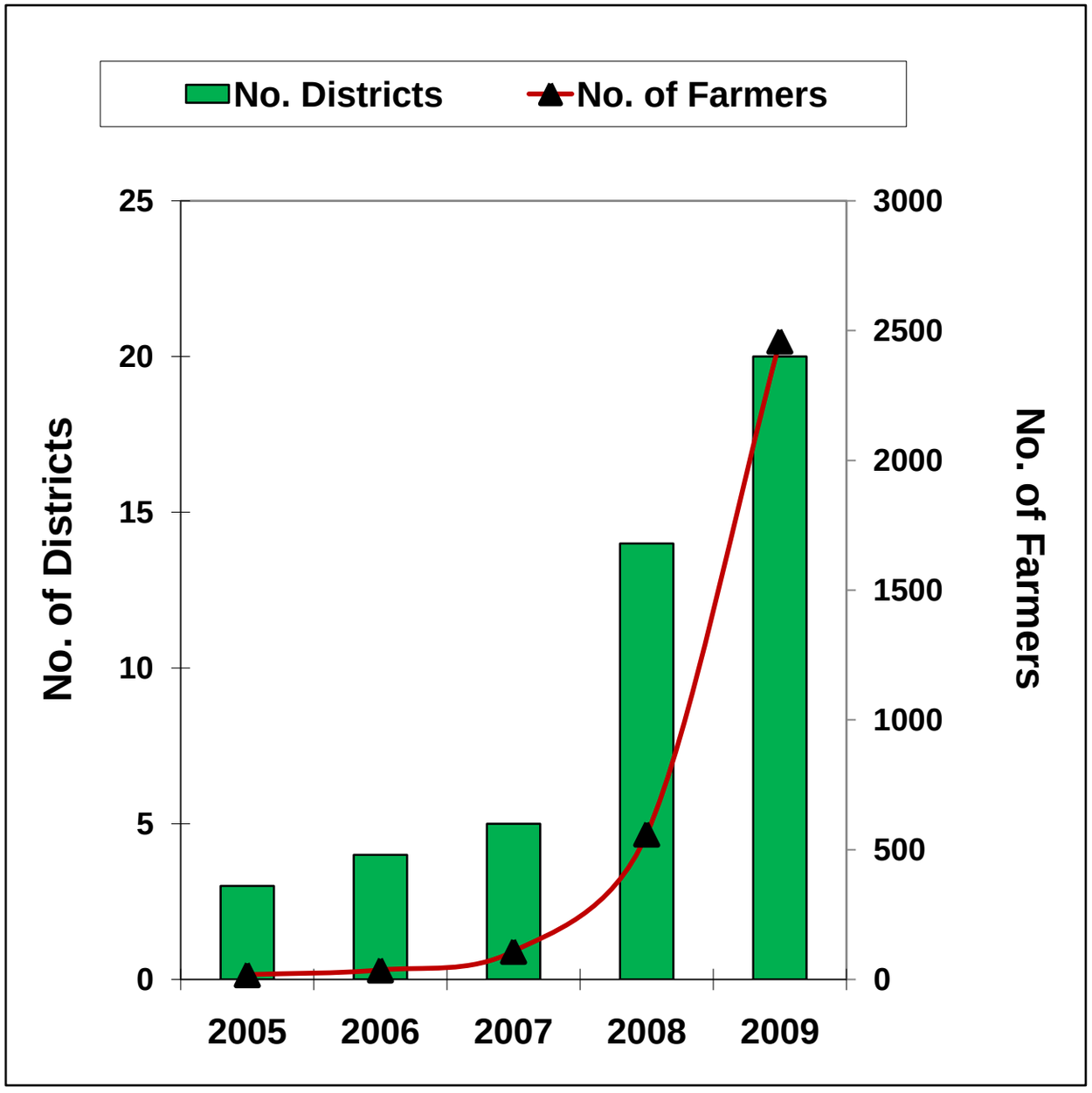
Labor and economic returns are higher under CA with less risk esp. with legume intercrops



Labor Costs (6 hr days)	Control Maize	CA Maize	CA Maize / Legume
Land Prep (Ridging/Clearing)	14.23	-	0.58
Laying Stalks	-	4.54	4.77
Planting Maize	6.30	6.72	7.53
Planting Legume (same time)	-	-	2.22
Basal Dressing	9.44	10.08	11.30
Weeding	8.28	-	0.69
Top Dressing	7.62	6.81	6.99
Drawing Water for herbicides	-	1.20	1.20
Herbicide Application	-	5.78	4.21
2nd Weeding/Banking	13.00	1.81	-
Harvesting	2.82	2.98	4.73
Total Labor Costs	**61.68**	**39.90**	**44.23**
Labor Savings %	**0%**	**35%**	**28%**

CA with irrigated crops in basins

Uptake of rainfed CA by farmers under TLC & CIMMYT since 2005



initial farmer skepticism quickly changed from visible benefits on crop yields and labor costs

INTEGRATION OF AGROFORESTRY PRACTICES TO IMPROVE SOIL HEALTH

Intercropping *TEPHROSIA* with MAIZE (2 Months)

Tephrosia candida:

<u>Year 1:</u> Intercrop with maize

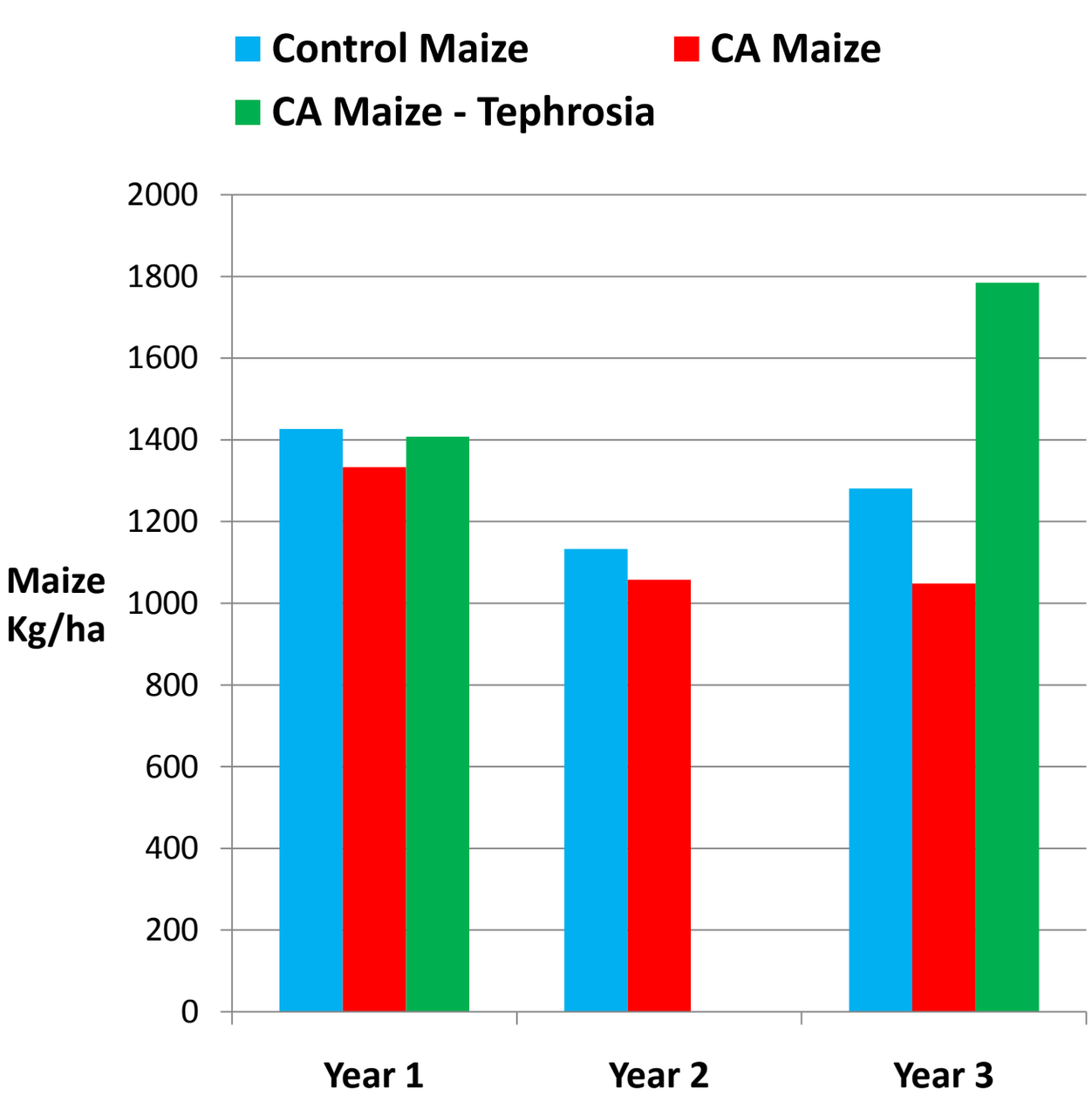
<u>Year 2:</u> Fallow, then remove, retain leaves on surface, wood for fuel

After Maize Harvest at 6 months – note leaf litter and the weed-free ground

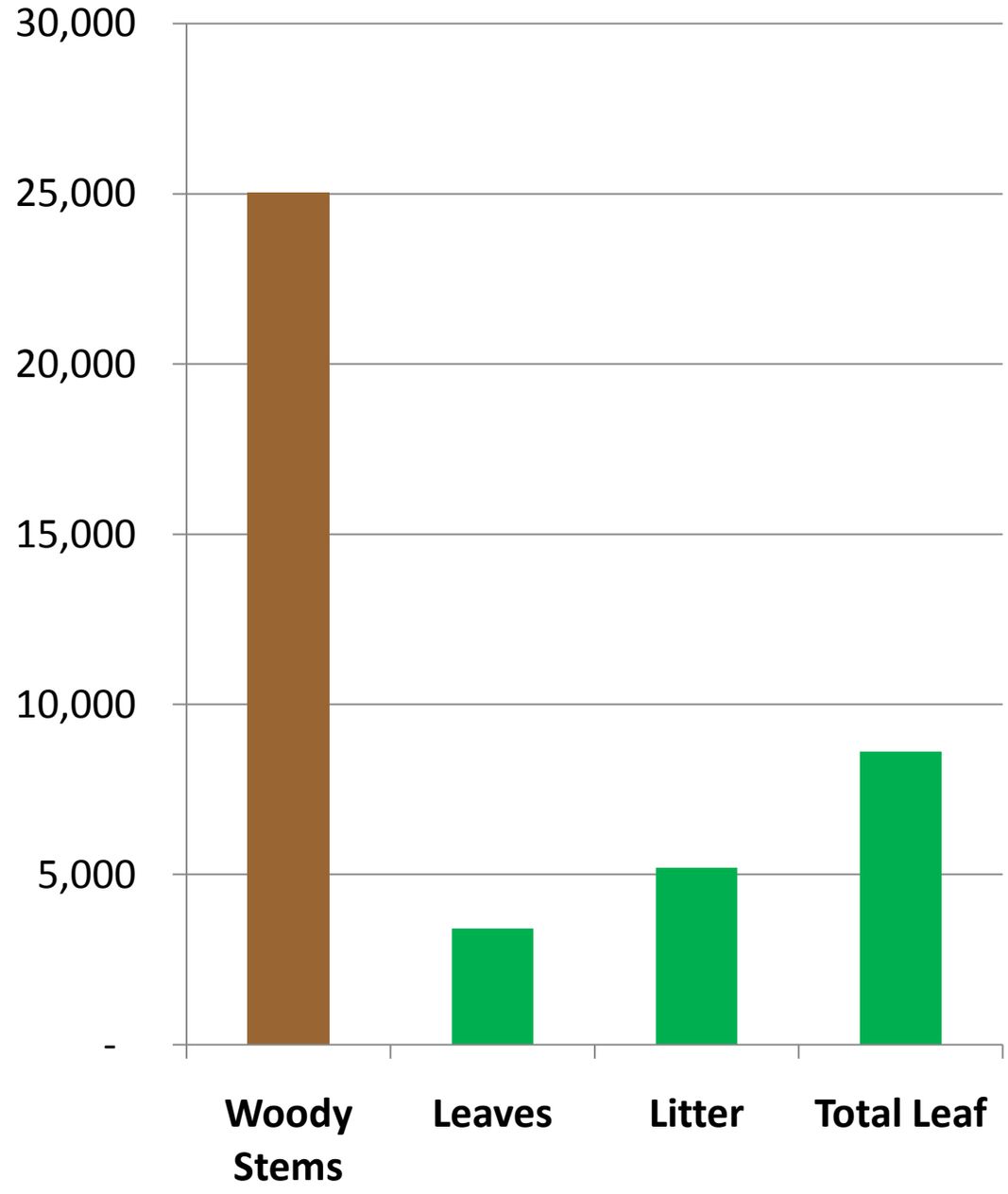
Dense canopy of fallow at 15 months requires no management or weeding

Yields improve with *Tephrosia* after the fallow in year 2

Maize yields w/o use of chemical fertilizer or herbicides



Tephrosia DM Biomass (kg/ha) at end of Year 2

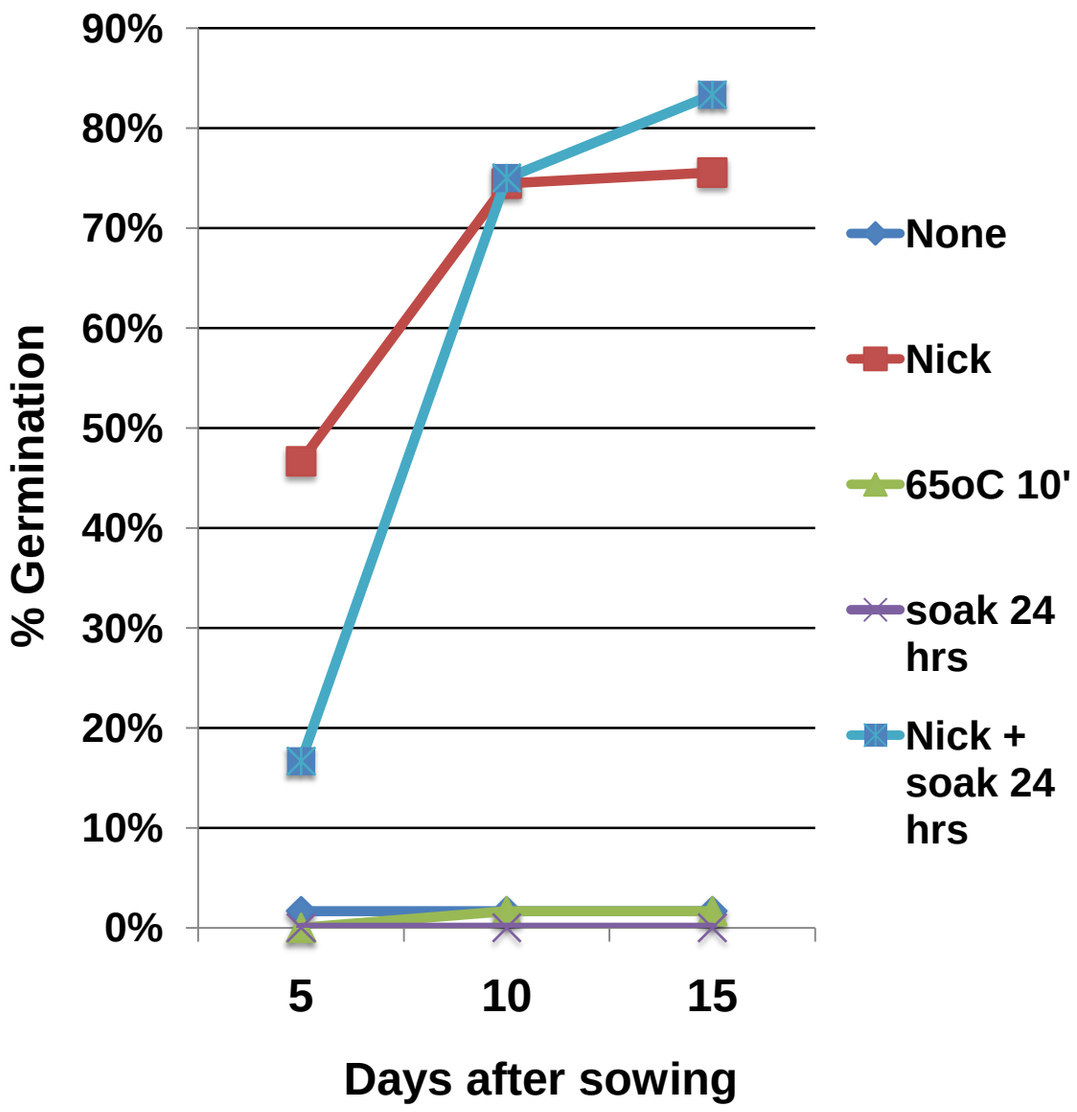


Integration of *Faidherbia* to improve crop yields & soil health with lower risks from climate change

Simple methods for healthy *Faidherbia* seedlings

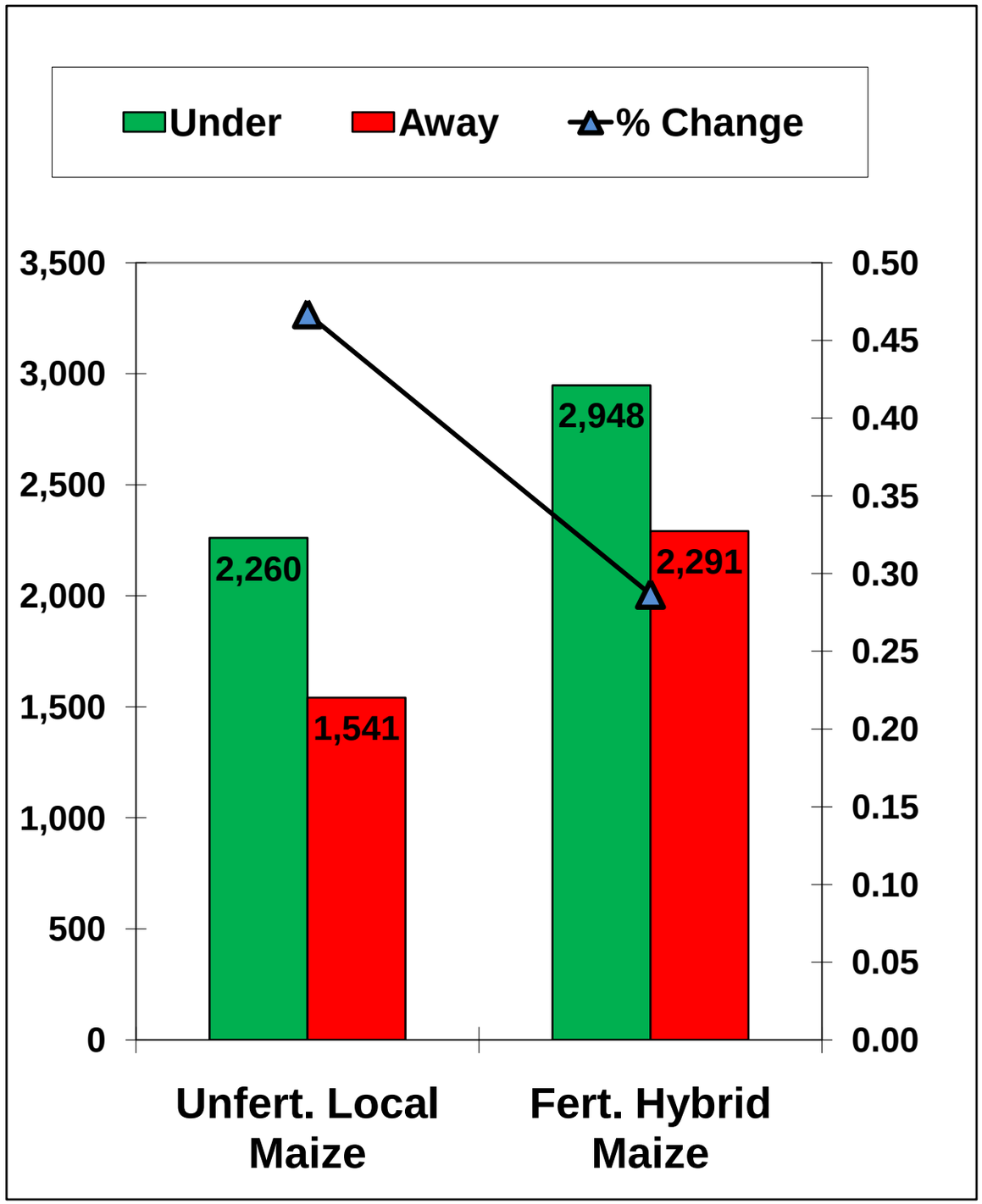
Nicking the seed is easy to ensure fast and uniform germination

Faidherbia albida



Village nursery on platform for air pruning to minimize damage to its root system

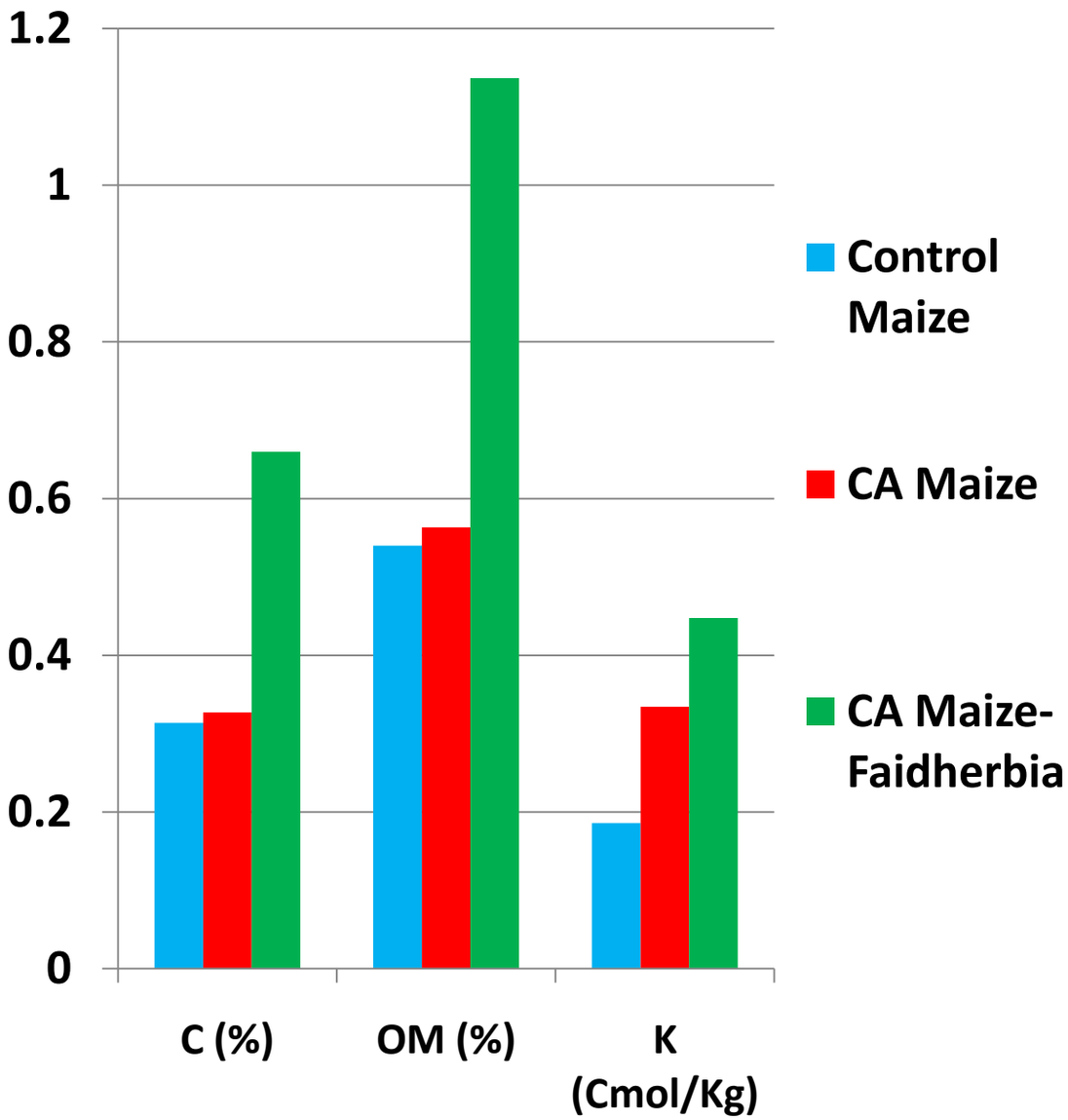
Maize yields under and away from *Faidherbia* trees with & without 1/3 of Fertilizer Recommendation



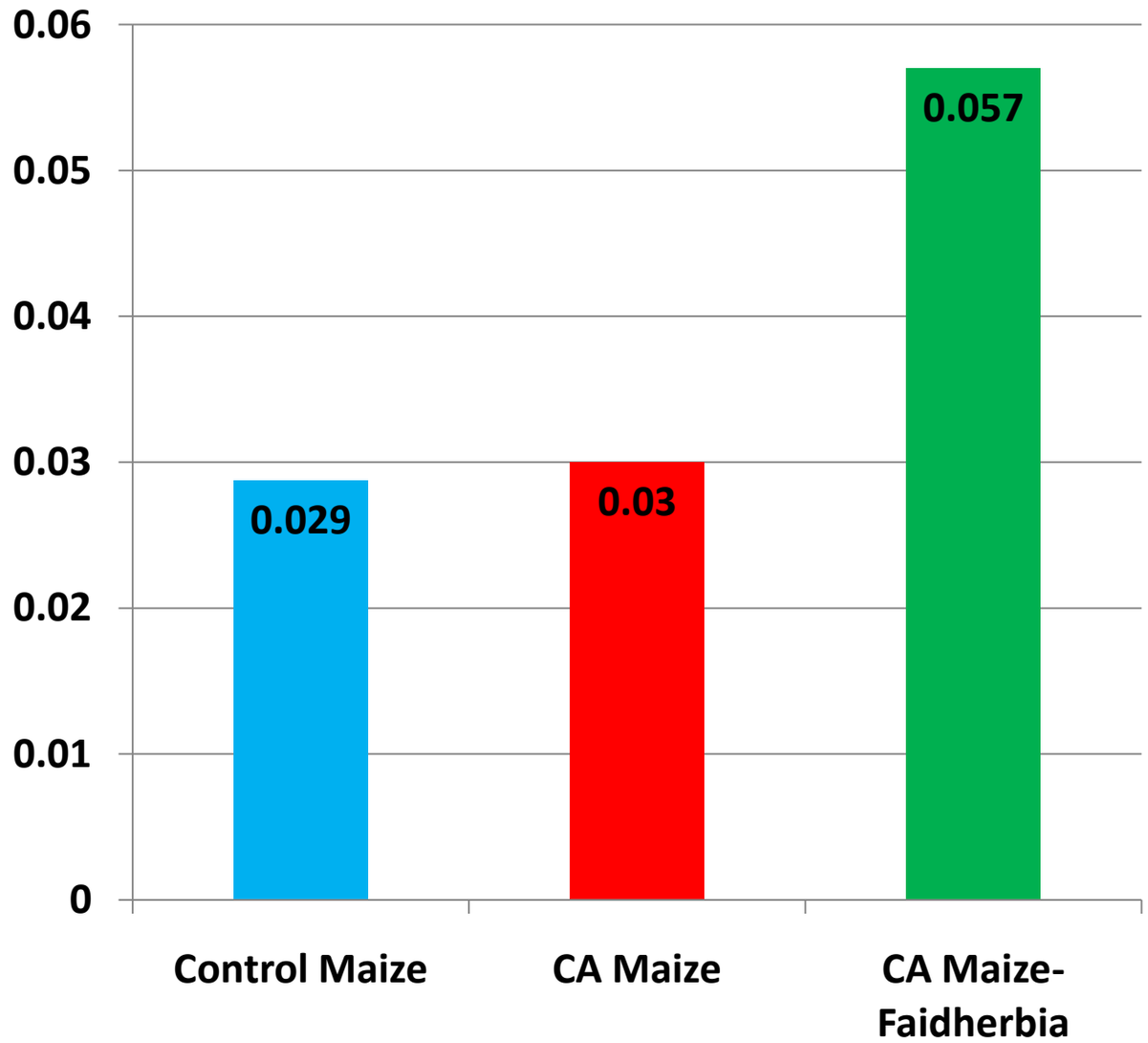
Maize yields with *Faidherbia* under CA are commonly 5-7 tons/ha from impacts on soil fertility, capture of rainfall and the micro-environment

Soils under *Faidherbia* are richer

Soil C, OM and K are much higher with *Faidherbia*



% Soil N is almost double with *Faidherbia*



Conclusions

- **Crop Yields:** CA produced higher and more stable yields in a short period of time; impacts are expected to increase with soil improvements
- **Labor Costs:** CA saved significant labor for manually demanding operations, allowing time for other important farm and household tasks
- **Uptake:** Visible benefits have been instrumental in generating broad interest in CA among farmers within & outside project areas
- **Agroforestry:** Certain practices show great promise to complement the multiple benefits of CA to enhance production and sustainability
- **Conservation:** Bio-physical impacts on Malawi's soils, water and capture of rainfall are vital to its people, economy, environment and agriculture
- **Vulnerability:** The multiple benefits of CA build capacity for adaptation and resilience to nature and climate change
- **Smallholder Farming:** CA provides a compelling story to transform smallholder agriculture in southern Africa with conservation of its valuable natural resources for future generations

Challenges for Scaling Up

- **Increase awareness & break norms of ridging, burning and clearing weeds /crop residues / debris from farm lands (farmer managed demos are critical)**
- **Increase access to low interest loans among farmers to secure inputs**
- **Provide quality training & extension services to field staff as well as farmers**
- **Institute national campaigns to leverage resources to mobilize out-reach efforts with multiple stakeholders**
- **Document the bio-physical claims of CA in Malawi and the region in terms of:**
  - Application with other crops
  - Reduced runoff and loss of top soil
  - Improved soil properties
  - Carbon sequestration / reduced CG emissions
  - Reduced weed biomass & seed reservoirs
  - Reduced need for herbicides over time
  - Control of pests/disease with legumes
  - Complimentary effects of agroforestry