



SysCom India: Research Highlights from a Long-Term Experiment in the Tropics

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SysCom

Farming **S**ystems **C**omparison in the Tropics

Objective: Generate scientific evidence on potentials and limitations of organic and conventional farming systems in the tropics.

Implementation: Long-term experiments (LTE) and participatory on-farm research (POR) comparing different organic and conventional farming systems in 3 tropical sites.

The SysCom Program

SysCom Bolivia 



Organic vs conventional
(monoculture or agroforestry)

SysCom Kenya 



Organic vs conventional at low
and high input level

SysCom India 



Organic and biodynamic vs
conventional with/without GMO

 **ECOTOP**

 FUNDACION
PARA EL DESARROLLO SOSTENIBLE
PIAF - EL CEIBO

 Instituto de
Ecologia

 **icipe**
African Insect Science for Food and Health

 **KALRO**
Kenya Agriculture & Livestock
Research Organisation

 **biore**
association | FKHARAT

Remei
India

Since 2007







SysCom 

FiBL

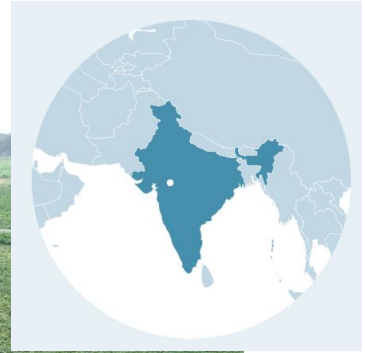
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Introduction - General

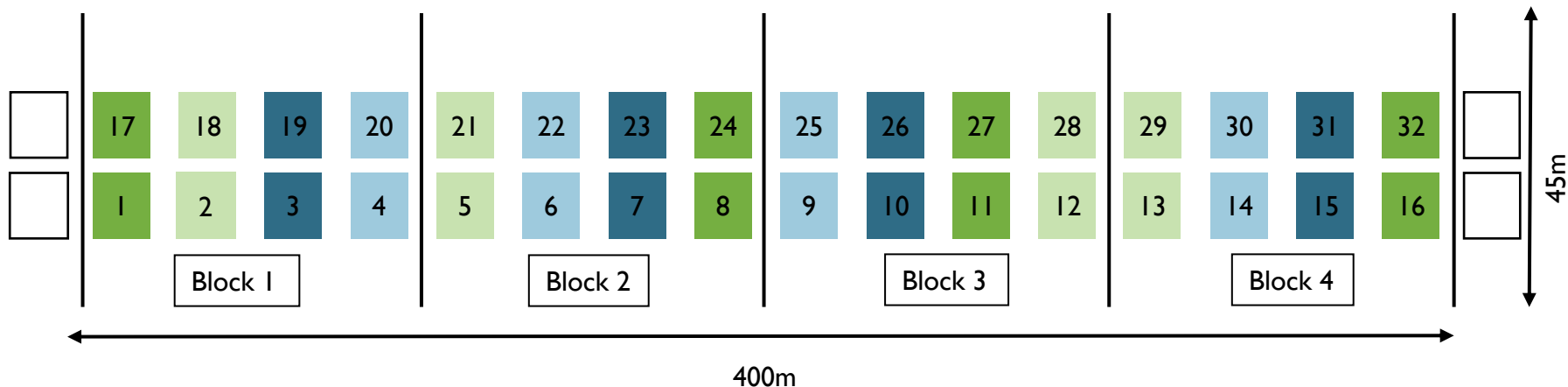
	Bolivia	Kenya	India
Site	South America – Bolivia Sara Ana	Sub-Saharan Africa - Kenya Central Highlands	South Asia - India Madhya Pradesh, Nimar Valley
Climate	Tropical-humid	Sub-humid	Semi-arid
	 	 	 
Crops	Cacao -based systems, cacao trees with plantain, coffee and timber trees	Maize -based systems, 3-year crop rotation with maize, vegetable and potato	Cotton -based systems, 2-years crop rotation with cotton, wheat and soybean
Systems	Organic vs conventional as monoculture or agroforestry	Organic vs conventional at low and high input level	Organic and biodynamic vs conventional with/without GMO

Long-term Experiment (LTE)





Long-Term Trial SysCom India | Layout



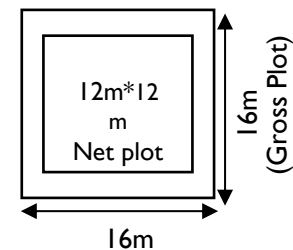
Treatments

- Biodynamic
- Organic
- Bt-Conventional
- Conventional

Two year Stripwise crop rotation

Organic and Biodynamic	Cotton, Chickpea, Green manure, Soybean, Wheat
Conventional and Bt-conventional	Cotton, Wheat, Soybean, Wheat

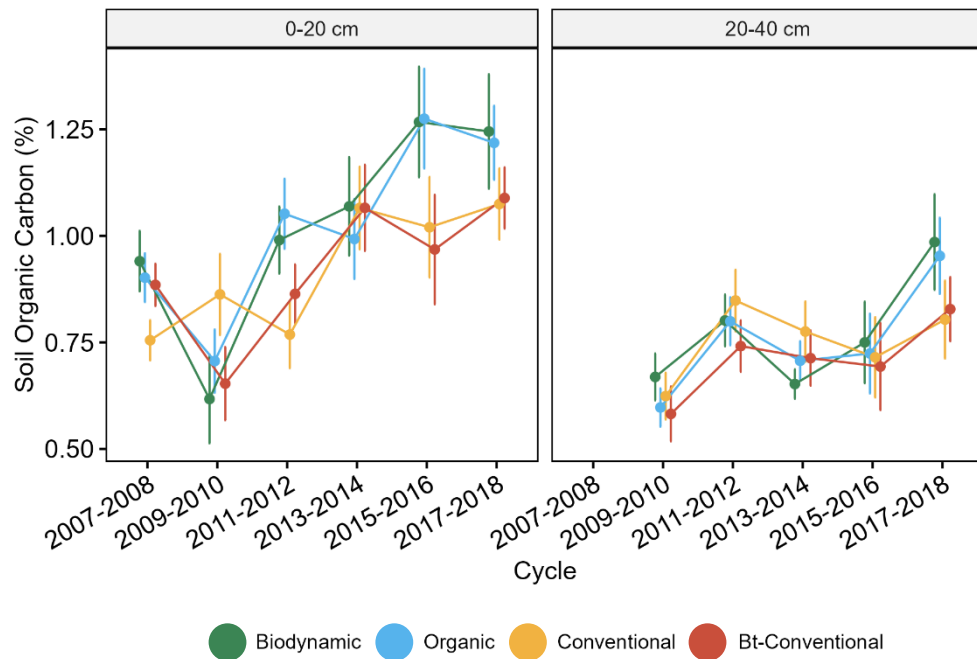
Individual Plot dimension



Research Highlights: Soil Quality

Soil Organic Carbon

Organic systems built up more SOC than conventional systems after 10+ years.



SOC stocks (*Singh et al. 2025*)

➤ Both **organic systems**: +13 %

SOC 2007-2024 (*Mathur, 2025*)

➤ Both **organic systems** +1.3 mg g⁻¹

➤ Both **conventional systems** -1.3 mg g⁻¹

Differences were only significant **after 10 years**.

System	SOC stock (t ha ⁻¹) 2016, 2018
BD	23.6 ± 0.23
ORG	22.8 ± 0.18
CONV	22.3 ± 0.28
Bt-CONV	17.6 ± 0.22

Singh et al. 2025

Soil Carbon Fractionation

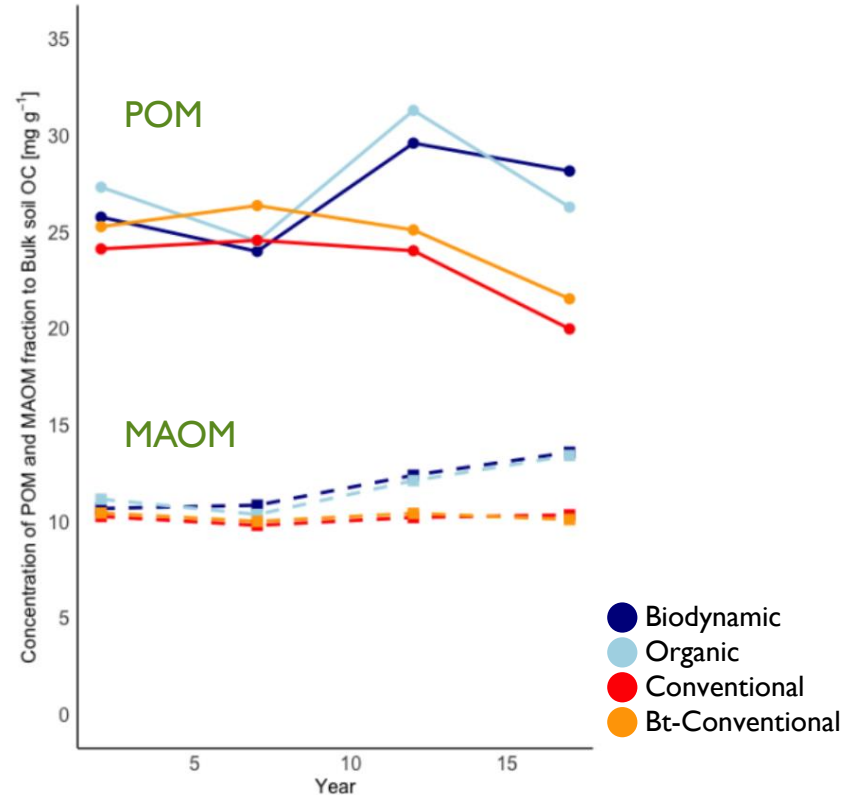
Organic systems: more stable and balanced SOC buildup.

Both organic systems:

- gradually increased MAOM and POM
- by year 12: higher POM & MAOM concentrations than conventional systems

POM: particulate organic matter (>20 μm)

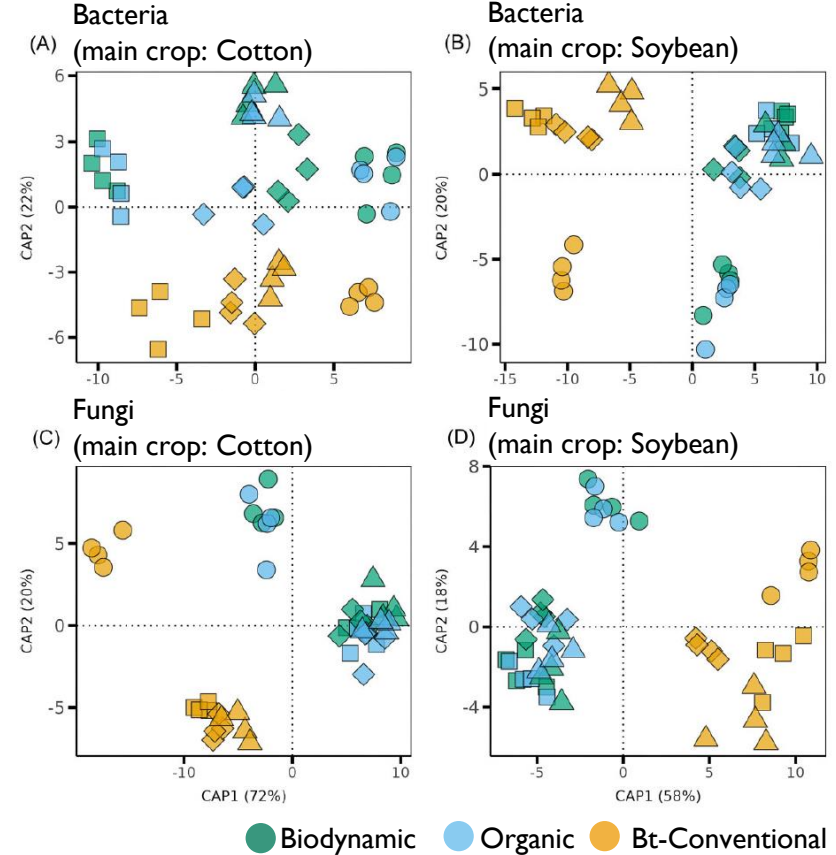
MAOM: mineral-associated organic matter (<20 μm)



Soil Microbial Communities & Soil Quality I

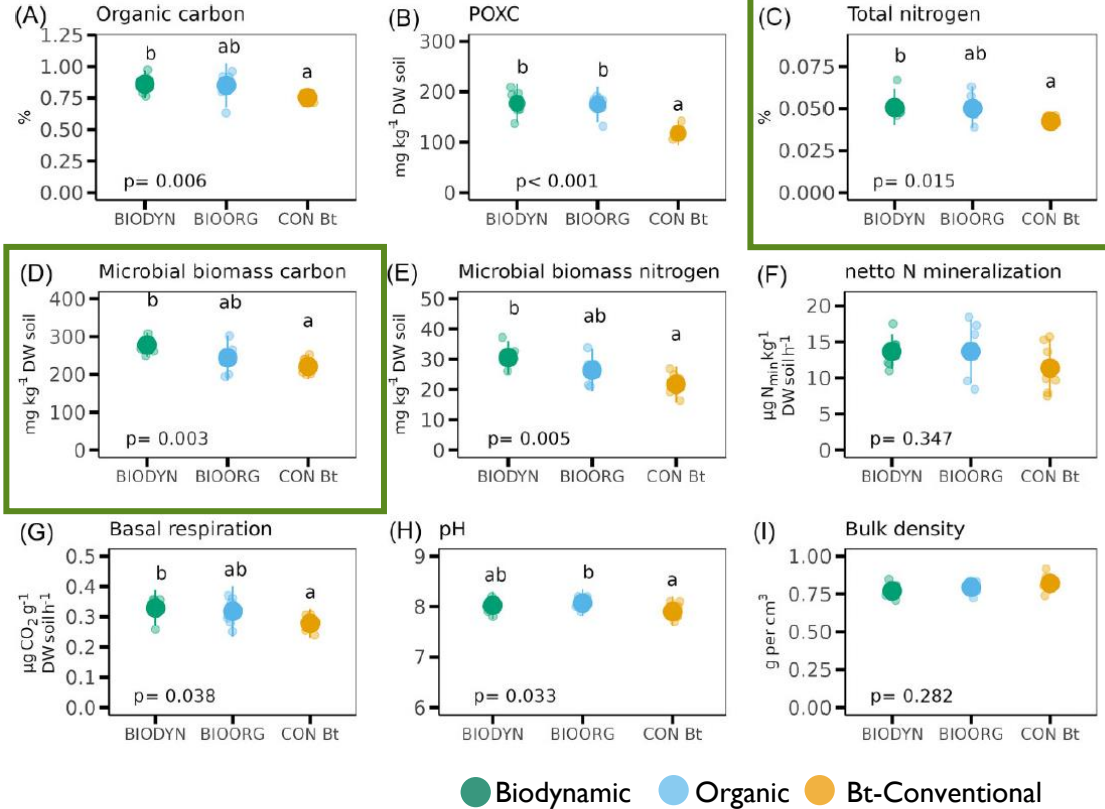
- Taxa identified in organic systems linked with **P mineralization** and **organic matter breakdown**
- Taxa identified in Bt-CONV systems linked with **Nitrifiers** (i.e. potential high nitrogen loss) and **potential pathogens** (*Fusarium*)

Distinct microbial communities in organic and Bt-CONV systems



Soil Microbial Communities & Soil Quality II

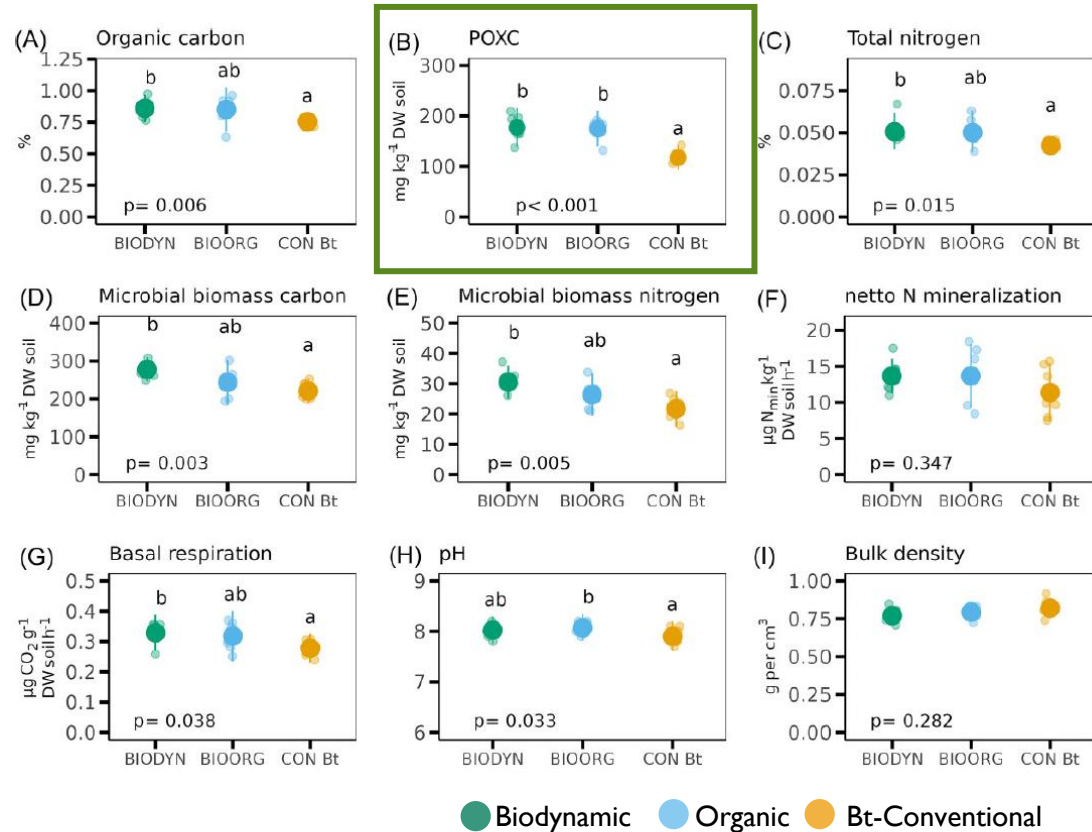
- Higher total N (+17.6 %) and microbial biomass carbon (+23.0 %) in BD systems vs. Bt-CONV systems.



Soil Microbial Communities & Soil Quality II

- Higher total N (+17.6 %) and microbial biomass carbon (+23.0 %) in BD systems vs. Bt-CONV systems.
- Higher POXC (+40.2 % and +38.9 %) in BD and ORG systems vs. Bt-CONV.

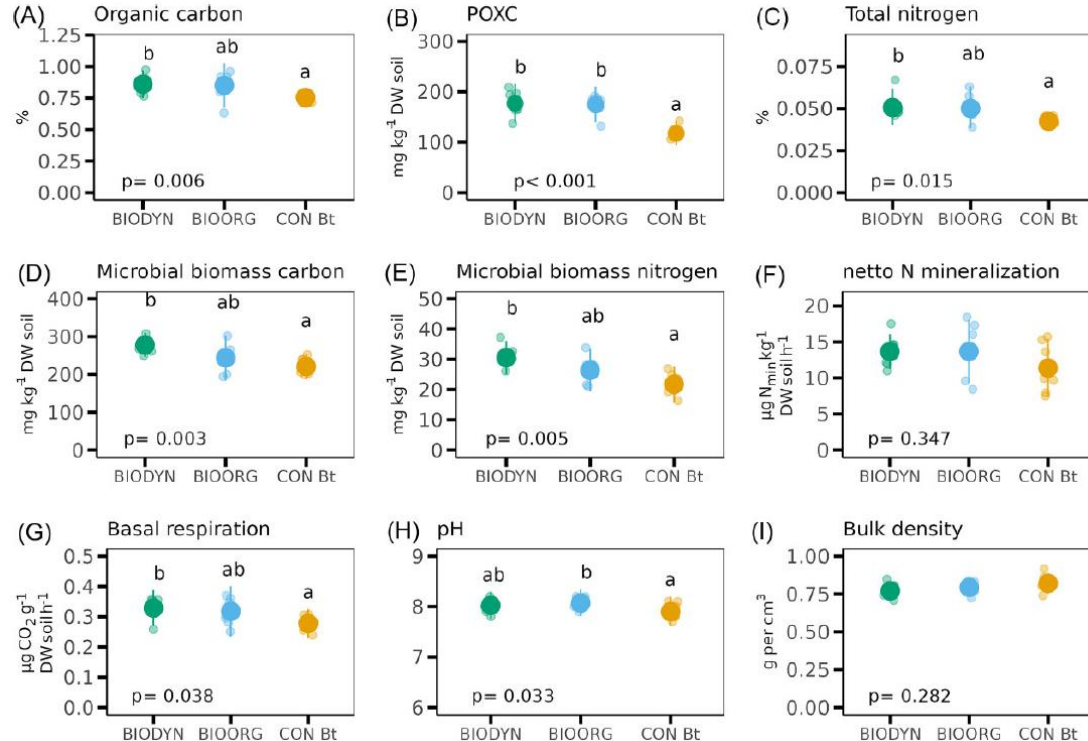
POXC: permanganate oxidizable carbon (associated with soil biological processes and indicator for soil quality)



Soil Microbial Communities & Soil Quality II

Organic systems improved soil quality after >10 years.

- Higher total N (+17.6 %) and microbial biomass carbon (+23.0 %) in BD systems vs. Bt-CONV systems.
- Higher POXC (+40.2 % and +38.9 %) in BD and ORG systems vs. Bt-CONV.
- Differences were not there yet after 7 years of the trial (*Bhat et al. 2017*) → long-term process!
- In another few years, we might start seeing differences between ORG and BD..?

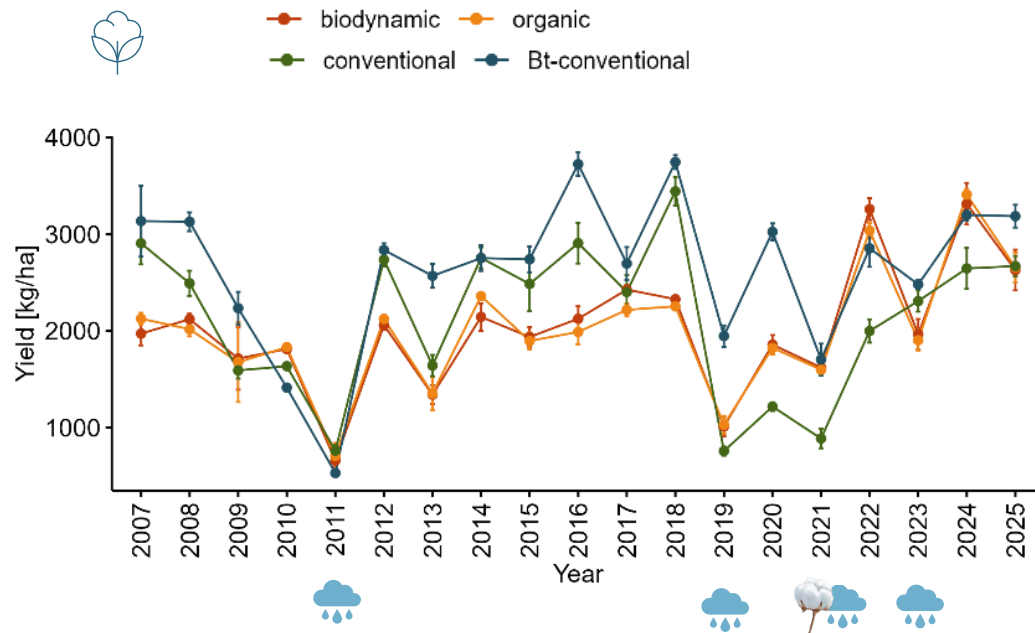


● Biodynamic ● Organic ● Bt-Conventional

Research Highlights: Productivity & Profitability

Cotton Yields

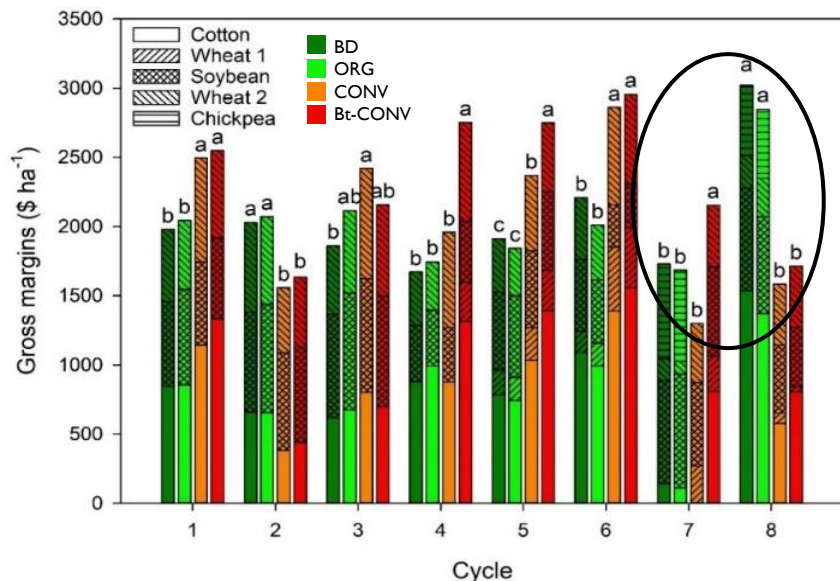
Organic cotton can match Bt-conventional yields – with good varieties and good management.



- Yearly Fluctuations
- Enabling factors: **adapted organic varieties, good soil fertility management**
- Limiting factors: erratic rainfall

Cotton Systems Profitability

Crop management and rotation diversity matter more than “organic vs. conventional”.



- Cotton: main driver of income and risk (77% of total gross margin variability)
- Bt-CONV highest mean gross margins (+11%), but...
- Organic & biodynamic systems remain competitive, due to:
 - lower production costs in soybean (-28 %)
 - good performance of legumes (soybean +16 % GM; chickpea highly profitable)
 - price premiums for organic cotton

Key Take Aways

- Better soil quality in organic systems: increased SOC, microbial biomass carbon and distinct beneficial microbial communities. But: it is a long term process – 10+ years.
- Organic cotton systems can match the Bt-conventional yields, with improved organic varieties and good management .
- Good crop management and rotation diversity matter more than “organic vs. conventional” in terms of profitability.



Outlook:
**How long-term is the SysCom
India long-term experiment?**

Transition Phase

Open for new cooperation partners and support.

- Current phase ends 2026 (20 years). Continuation of LTE unclear as of now.
- Transitioning to a model with stronger local ownership and more embedded in national research landscape
- Discussions ongoing with different national NGO's and funding agencies.
- Strong interest from BDAI (Biodynamic Association of India) for establishment of first biodynamic hub.



Future Outlook

Open for new cooperation partners and support.

- Vision: International Training and Applied Research Centre for Holistic Cotton-Based Systems
- «Living Lab» for organic and biodynamic research with strong farmer engagement
- Potential research focus: one health approach – interconnectedness between soil biodiversity, plant nutrients, above- and below-ground biodiversity and human health.



Staff offices



Conference rooms



Screenhouse



Guest accommodations



Soil lab for in-house testing

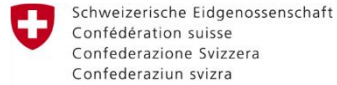


Up to 700 visitors yearly to research station

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Local partners India



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Thank you

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