

# Functional biodiversity in organic and conventional cotton farming systems

## Introduction

### Background

- Cotton crops are the crops which consume the most pesticide in the world.
- India is the biggest cotton producer in the world, despite this, the cotton yield is one of the lowest in the world yield per hectare. The main reason for low cotton yield is due to pest attacks and low soil fertility.
- Majority of the study of pests in India focuses on bollworms study, however, other pests such as jassids and aphids are seriously affecting cotton production.
- Functional biodiversity includes beneficial organisms that can provide services such as natural pest regulation through natural enemies and play a significant role in the generation of soil fertility.

### Aim

To compare the long-term impact of four cotton farming systems (biodynamic, organic, conventional and Bt-conventional(GM)) on functional biodiversity with a focus on pest regulation and soil health.



## Methods

### Survey site

- The long-term trial was started in 2007 by FiBL (Figure 1)
- It is a 2 years rotation crop system with Soya, Wheat and Cotton crops
- 4 cotton farming systems (2 organic systems, 2 conventional systems)
  - Biodynamic
  - Conventional
  - Organic
  - Bt-conventional (GM)
- Location: Madhya Pradesh, central India
- Time of surveys: From May to December (cotton season)

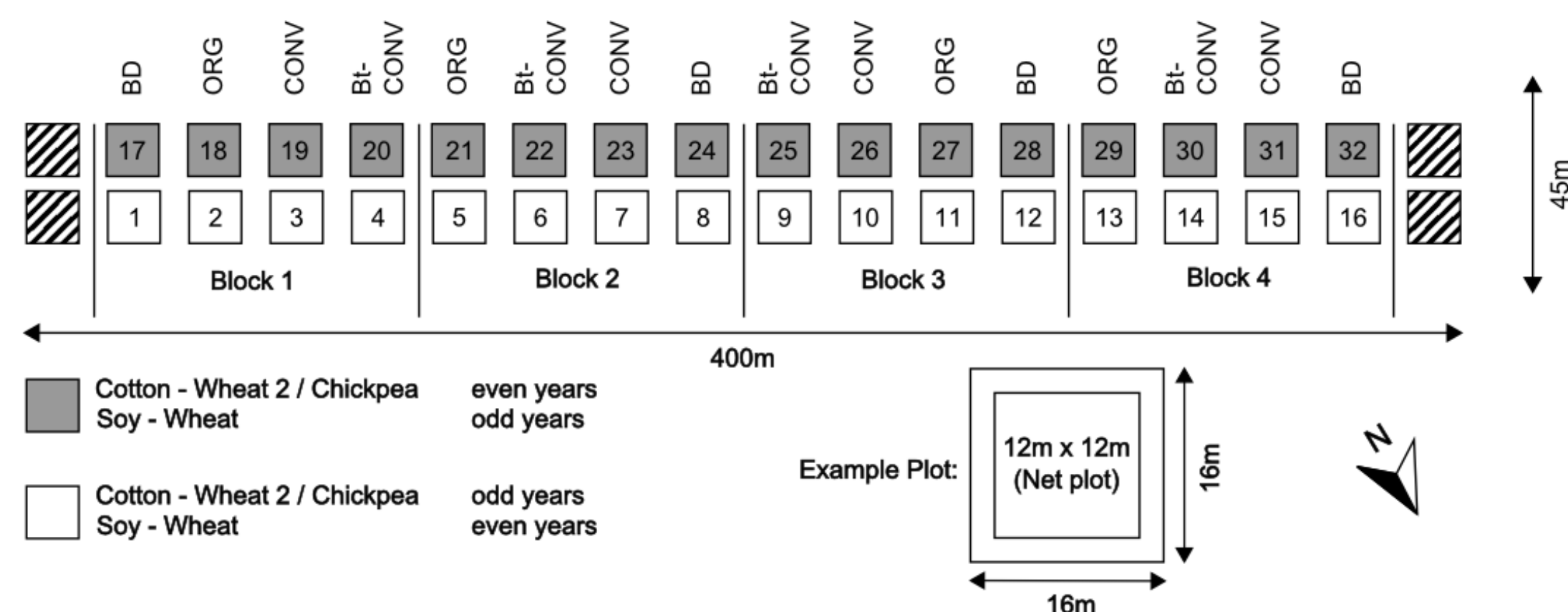


Figure 1. The SysCom long-term trial rotation crop system (soya, wheat and cotton) in Madhya Pradesh, India with 4 farming systems: biodynamic (BD), organic (ORG), conventional (CON) and Bt-conventional(BT)

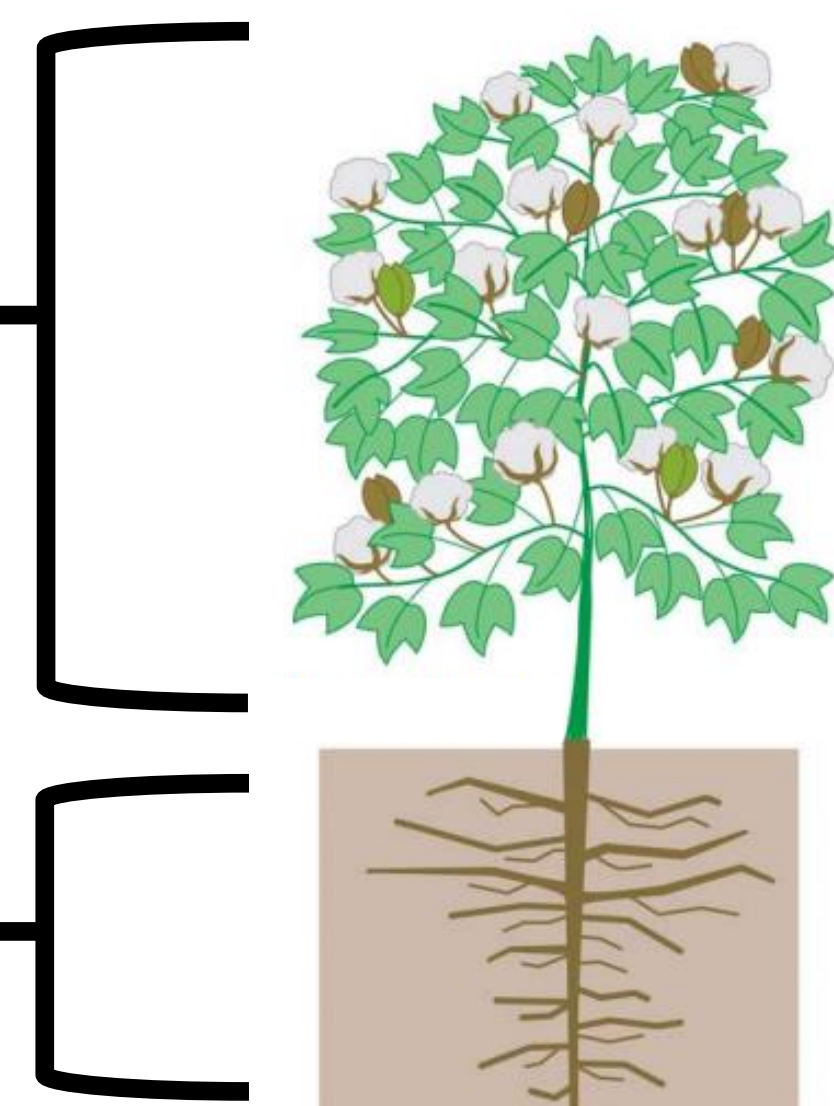
### Ecological Surveys

#### Aboveground biodiversity (4 times a year)

- Canopy-dwelling arthropods (2016-2017)
- Ground-dwelling arthropods (2016-2017)

#### Belowground biodiversity (4 times a year)

- Earthworm (2017-2018)
- Fungi (2017)



- Earthworms are regarded as the soil bio-indicators of soil quality (Kula et al., 2015)
- Trichoderma fungi have been used as an indicator of soil health (Awad-Allah et al., 2023)

## Results

### Aboveground ecological surveys

- The number of *Araneae* (predators) was significantly higher in both organic systems.
- The number of *Cicadellidae* (pests) was non-significantly different between the 4 systems.
- The ratio pest: predators was higher for Bt-conventional and conventional and lower in organic and Biodynamic systems (Table 1).

### Belowground ecological surveys

- The earthworm's density (Figure 2) were significantly higher in both organic systems in comparison to both conventional systems during the surveys 2017-2018.
- The presence of *Trichoderma* fungi colonies was significantly lower in both conventional systems in comparison to both organic systems (Figure 3).

Table 1. Summary of the Pest: Predators ratio of the ecological surveys 2016-2017 in the canopy-dwelling and in the ground-dwelling arthropods community.

Farming systems	pests : predator ratio	
	Canopy-dwelling community	Ground-dwelling community
Biodynamic	1.3 : 1	6.8 : 1
Organic	1.2 : 1	8.5 : 1
Conventional	2.5 : 1	10.8 : 1
Bt-conventional	2.6 : 1	8.7 : 1

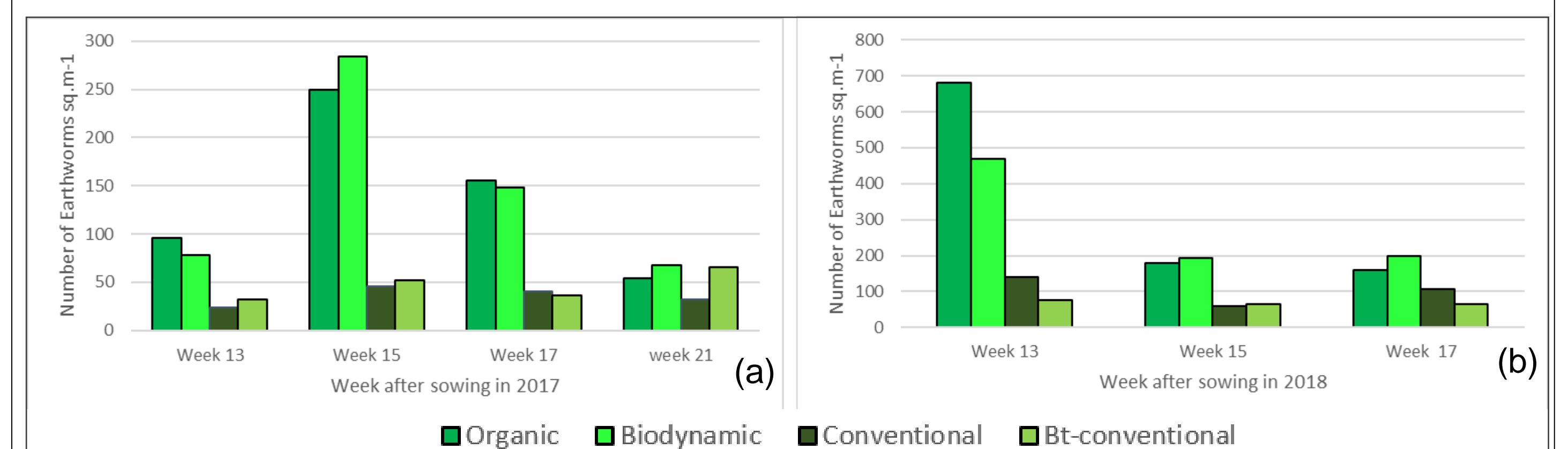


Figure 2. Earthworm density per square meter for the survey 2017 (a) and 2018 (b) on the long-term trial comparing organic, biodynamic, conventional, Bt-conventional cotton systems.

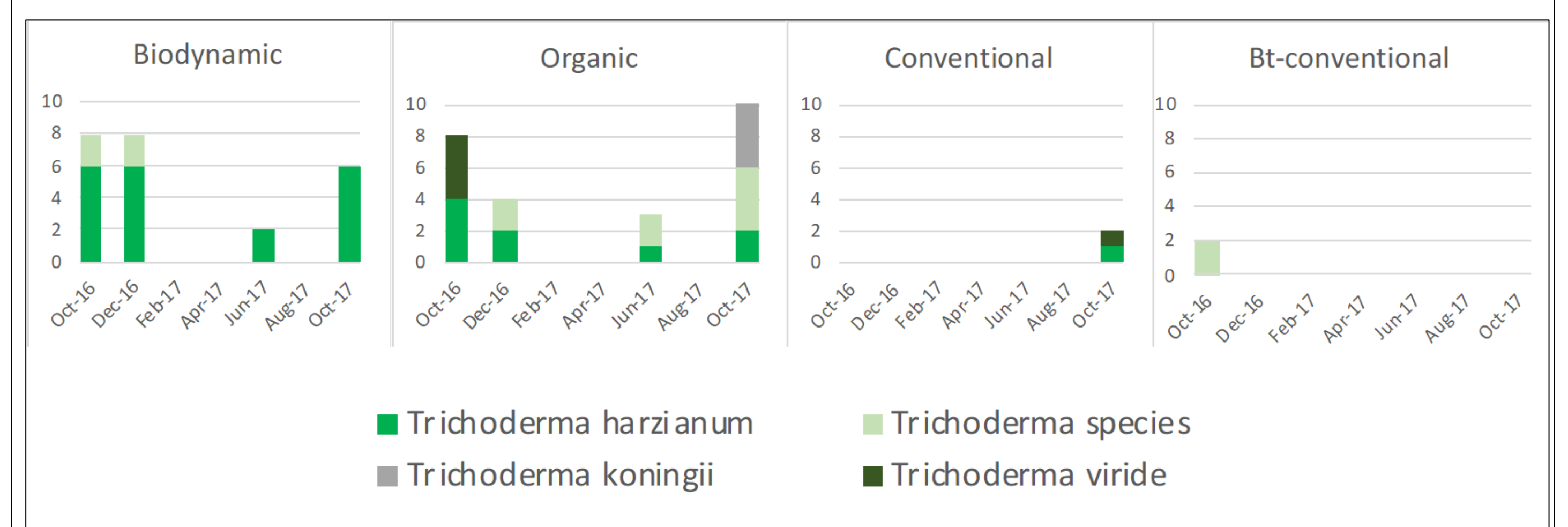


Figure 3. Presence of *Trichoderma* fungi colonies in soil samples from the long-term management of four cotton farming systems (biodynamic, organic, conventional and Bt-conventional) during the years 2016 and 2017.

## Conclusion

### Aboveground ecological surveys

- On the long term, organic systems (biodynamic and organic) have a stable ecosystem (higher predators per pest ratio).
- The number of pests in conventional systems is not lower than organic systems, which can question the efficacy of pesticides used.

### Belowground ecological surveys

- Conventional systems have a negative effect on the below-ground biodiversity in comparison to organic systems.

**Functional Biodiversity is higher in both organic systems**

Extract from PhD thesis: 2021,Christelle Ledroit, Socio-Ecological sustainability of cotton farming systems in central India, Coventry University.

### References:

Awad-Allah E., Mohamed I.A.A.,Awd Allah S.F.A.,Shams A.H.M., Elsokkary I.H.,2023, Trichoderma Species: An Overview of Current Status and Potential Applications for Sustainable Agriculture, Indian Journal of Agricultural Research, Vol 57 (3), p273-282

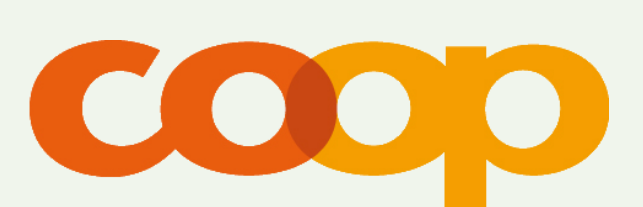
Kula S., Koirala M., Khadaka U.R., 2015, Earthworm population in relation to different land use and soil characteristics, *Journal of Ecology and the natural environment*, Vol 7 (5), pp 124-131

### Donors

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