Agroecological Transition of Food Systems in Africa

Climate resilient production systems: Agroecology for enhanced productivity, soil and livestock

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Practices of Agroecology

1. *Crop diversification (e.g., intercropping; crop rotation; role of legumes; role of neglected species)*
2. *Agroforestry, crop-livestock integration*
3. *Organic fertilization systems (manure, compost and other local inputs)*
4. *Mulching*
5. *Biological pest and disease control (e.g., integrating traditional and innovation; use of plant extracts)*

Crop diversification

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Crop diversification: Intercropping and Neglected and Underutilized species

- In **Burkina Faso**, biomass production and grain yields had better trends compared to the single cropped species either for **cowpea, fonio and sorghum**
- In **Ghana**, in addition to the advantages of the intercropping outlined above in Burkina Faso, it allowed weed control while improving land productivity in **cassava** cropping systems.
- In **Ghana**, LER>1 for fonio/cowpea intercropping system across all the 4 sites indicating the positive agronomic convenience of this association

Fonio/Cowpea intercropping plot in an additive module of 1:1 ratio (Credits: KDC, Ghana)

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Crop divesification: Agroecological Management for Improved Olive Production: No-Tillage and Cover Crops

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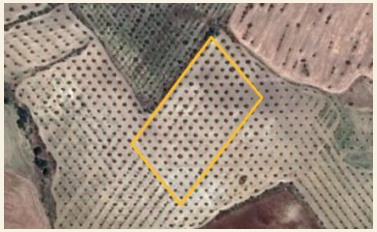
North of Tunisia : Toukaber, Beja Governorate

Orchard characteristics
-Cultivar: Chetoui
-Orchard: 30 ha
-Density: 156 trees/ha
-Trees age: 15 years
-**Rainfall: 500 mm**



Center of Tunisia: Jammel, Monastir Governorate

Orchard characteristics
-Cultivar : Chemlali
-Orchard : 70 ha
-Density : 30 trees/ha
-Trees age : 80 years
-**Rainfall : 300 mm**

T1: Farmer practices (tillage)

T2: Fava bean intercropping

T3: Fenugreek intercropping

T4: No tillage (natural cover crop)

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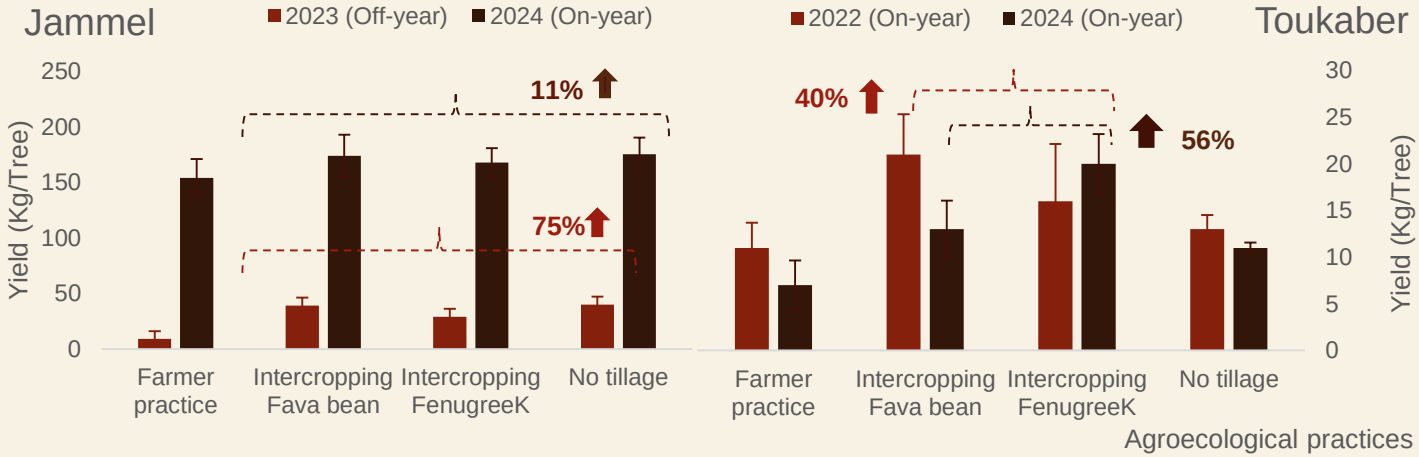
Crop divesification: Agroecological Management for Improved Olive Production: No-Tillage and Cover Crops



Soil-Specific Strategies:
Sandy, low-OM soils respond faster to interventions.
Clay soils require longer-term cover crop integration

Cover Crop Benefits:
Jammel (sandy soils): Yield increase with natural/fava bean intercropping.
Toukaber (clay soils): Yield increase, slower but sustained N-release.

Farmer adoption of cover crops can reduce fertilizer costs and enhance productivity

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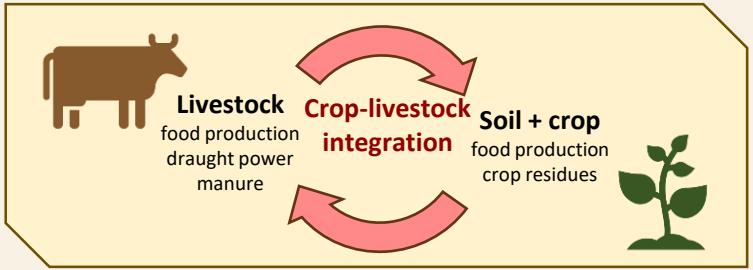
Agroforestry/crop-livestock integration



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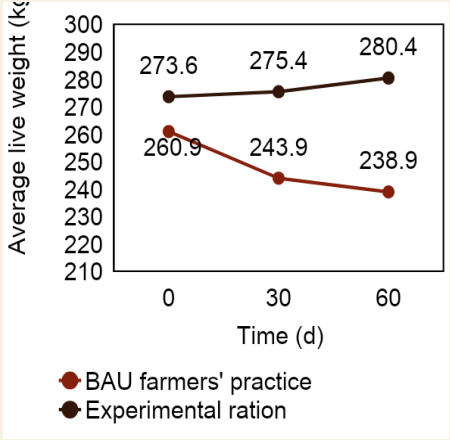
Crop-livestock integration: The case of cotton-based systems in Burkina Faso

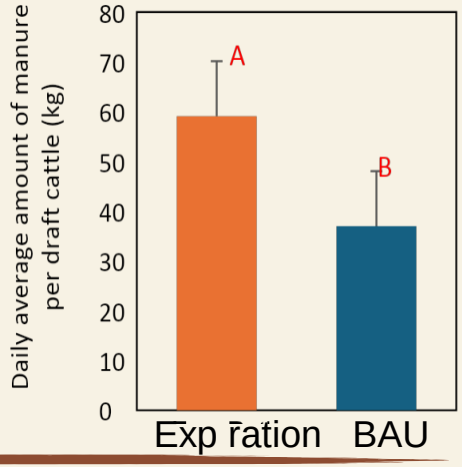
- **Crop residues insufficiently valorized by farmers in cotton-based farming systems in Burkina Faso, while cattle face a shortage of forage**

Optimized Experimental Ration: 3 kg sorghum stalks + 1.5 kg cottonseed cake

Main Results

- Sorghum stalk and cottonseed cake supplementation **improved draft cattle weight** and avoided weight loss (Fig. on the left) and **enhanced manure production** (Fig. on the right).
- **Slightly enhanced crop productivity** with organic manure application in combination with inorganic fertilizer
- **Valorization** of cotton residues and increased sustainability of cotton-based farming systems





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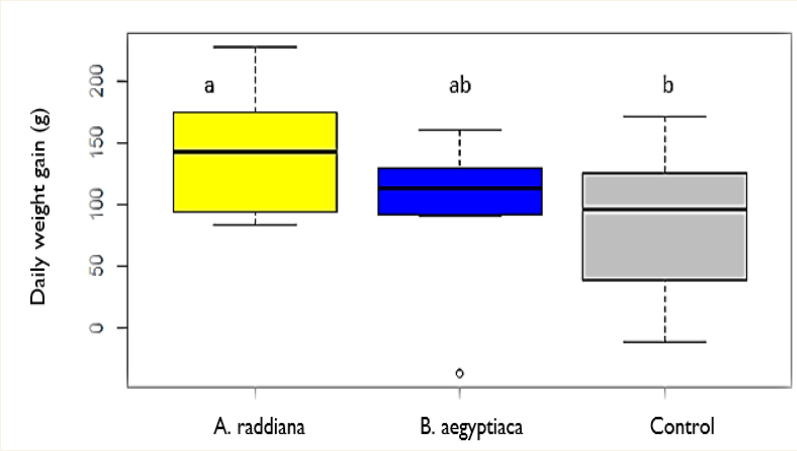
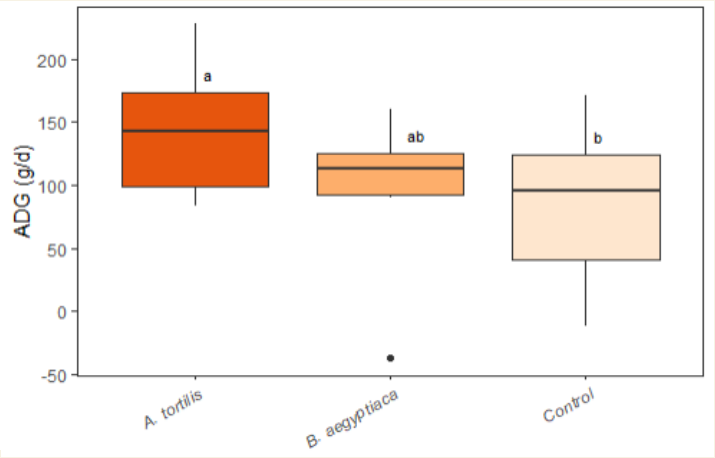
Agroforestry-livestock integration: Fattening performance of sheep fed with foliage-based diets

Senegal



Burkina Faso



Average daily liveweight gain (g) of sheep fed with *Acacia raddiana* pods, *Balanites aegyptiaca* leaves or farmers' habitual diet (control) in Senegal (left) and Burkina Faso (right).

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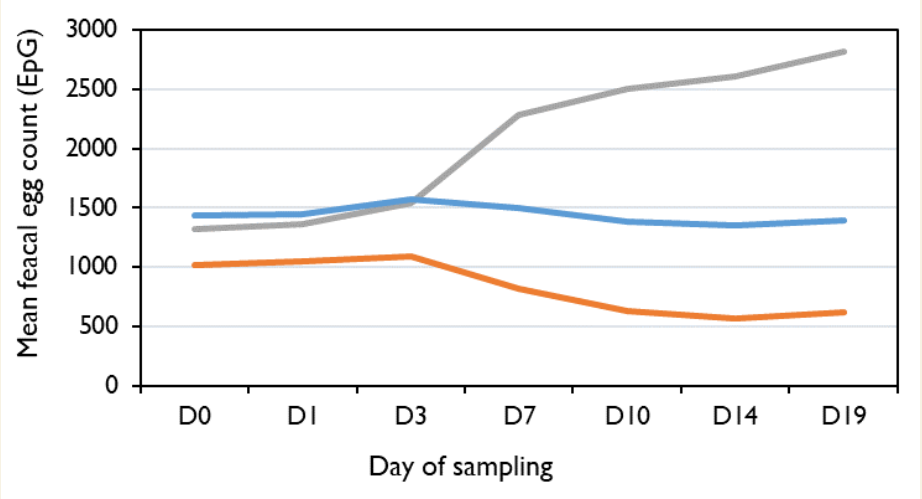
Agroforestry-livestock integration: On-farm efficacy tests of leaves against gastrointestinal nematodes in sheep in Mali

18 adult male and female sheep of different genetics naturally infested
Treatment: *Khaya senegalensis* and *Potamogeton lucens*
Control group: BAU ration (n=1 per treatment and farm, tested on 6 farms with 3 sheep/farm).



grey: control
blue: *P. lucens*
orange: *K. senegalensis*

Anthelmintic efficacy of leaves against sheep's gastrointestinal nematodes in Mali.

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Aquaculture and sustainable fish production systems in Ethiopia

- Soybean-based **local fish feed** improved growth performance of Nile tilapia closely matching the expensive commercial feed => Farmers are advised to use soybean fish feed for their fish culture.

Tilapia culture using the Hapa net in Koga Irrigation Water Reservoir, Ethiopia.

Recirculatory tarpaulin fish holding tank for production of fish and management of water quality

Fish feed produced from locally available ingredients

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Climate resilient production systems: Agroecology for enhanced productivity, soil and livestock

Organic fertilization systems

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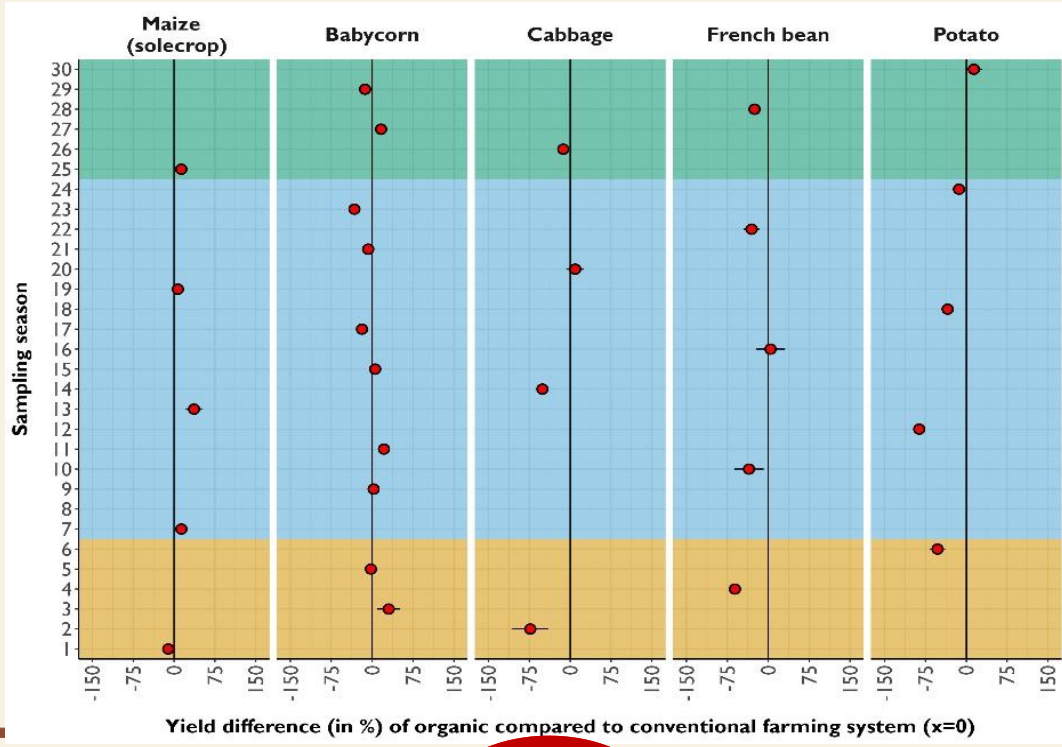
Organic vs. conventional systems comparison in Kenya

- No significant differences between systems in babycorn
- Conventional system higher in cabbage, French bean, and potato
- Reduced yield gap in 5th rotation
- Organic system higher in maize sole crop



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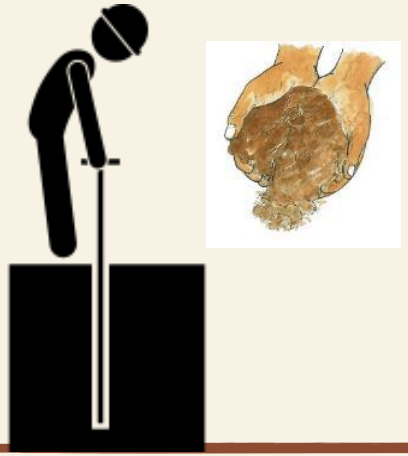
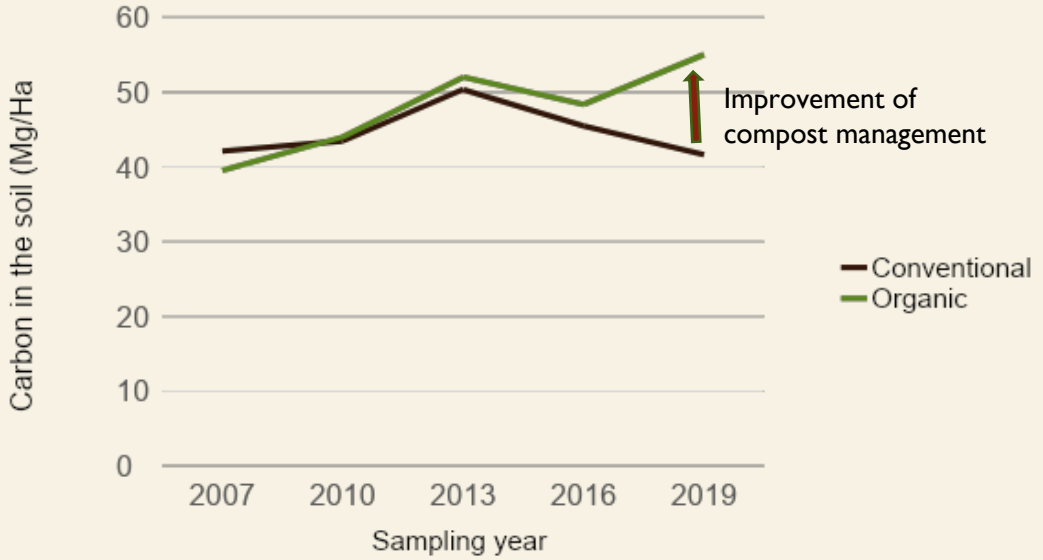
Long-term impacts of organic agriculture on soil carbon in Kenya

Soil Carbon after 12 years in Kenya





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Mulching with shrubs and trees

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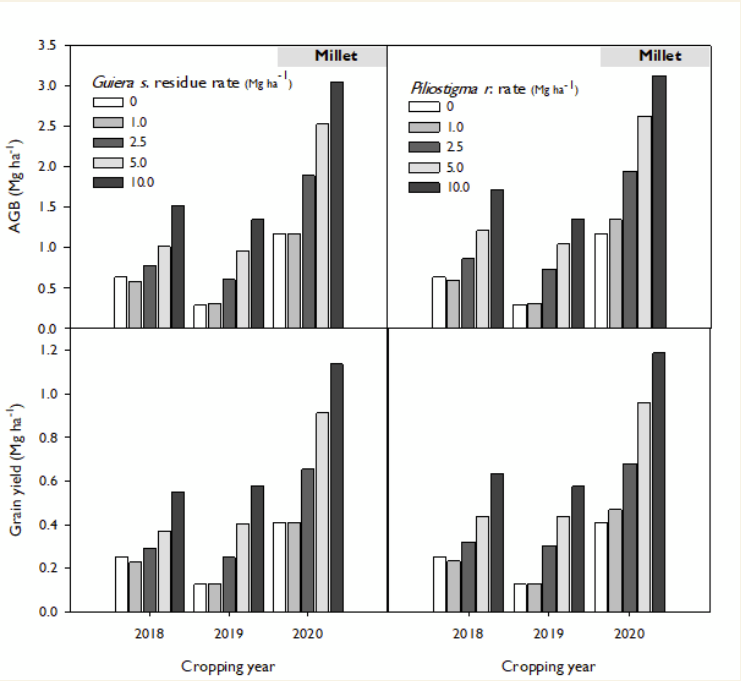
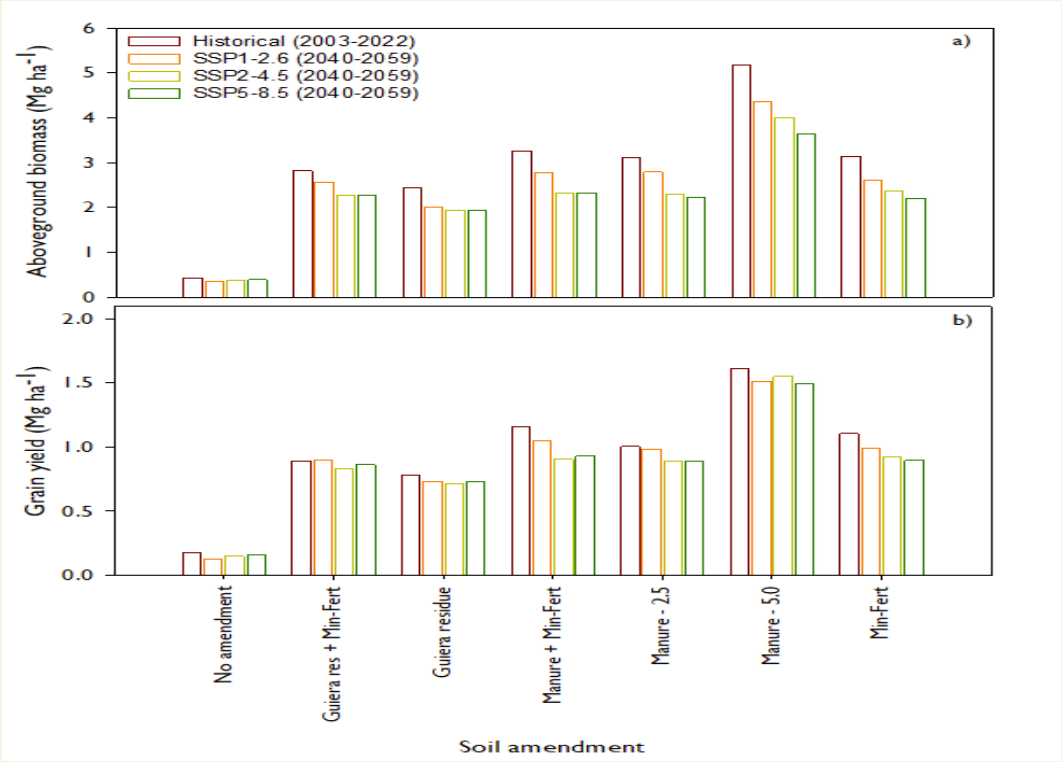
Modelling the impact of shrub mulching on millet yields





(Eric Komsoon U of Hohenheim)

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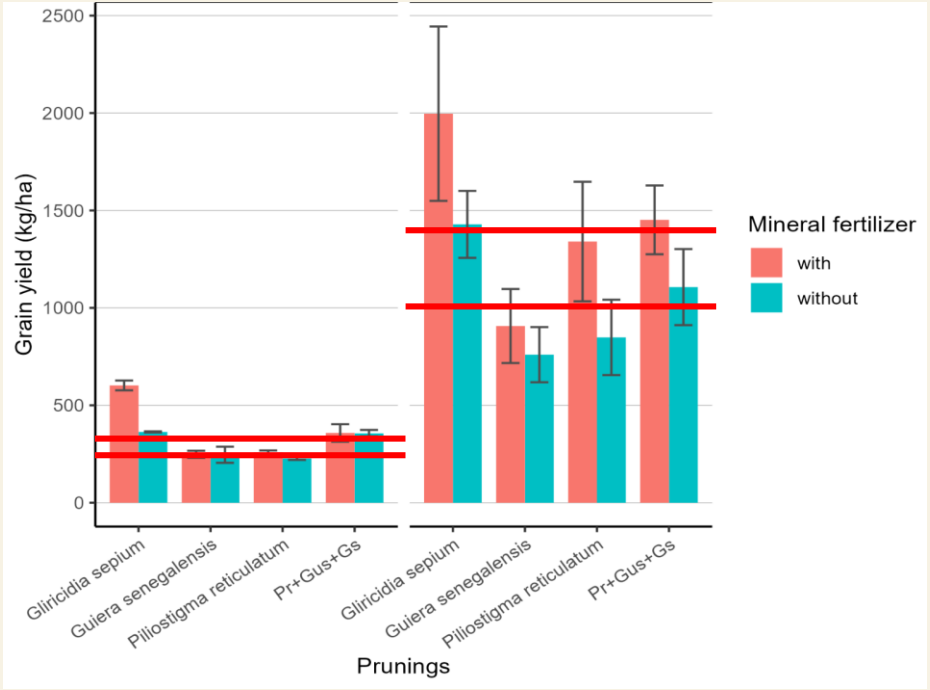
Mulching: Shrub mulching on millet productivity in Mali



(Souleymane Kone, IPR)

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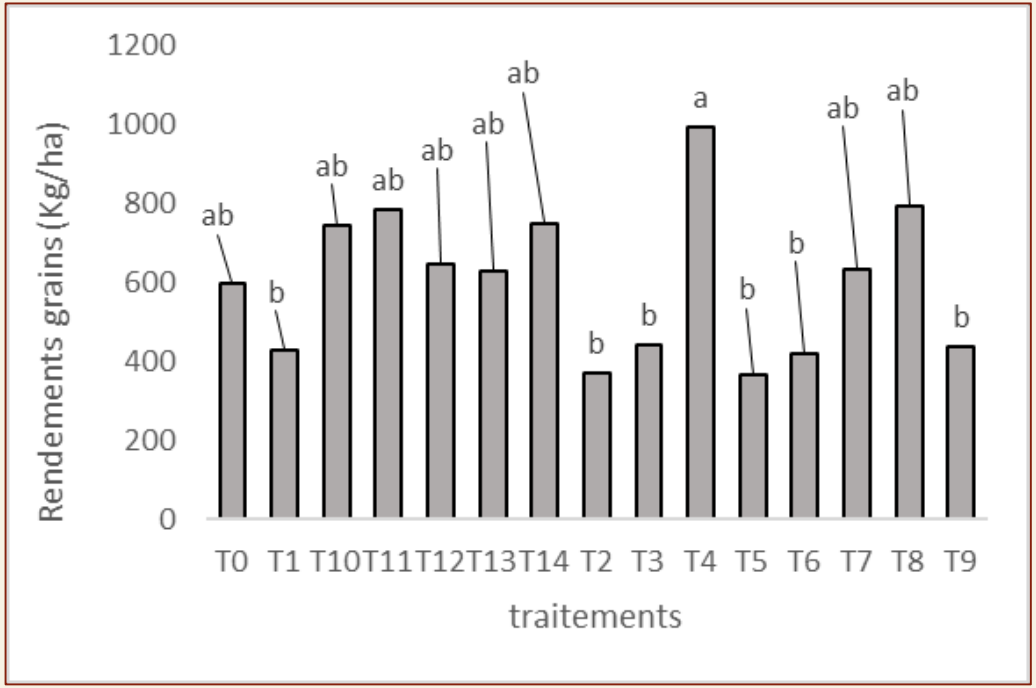
Mulching: Mulching on sorghum productivity in Burkina Faso



Sorghum yield: up to +50%

Mulching with Vitellaria (shea butter) and Neem tree are the most interesting formulation, followed by Vitellaria + ash.

T0: Control; T1: *P. reticulatum*; T2: *G. senegalensis*; T3: A. indica; T4: *V. paradoxa* + 1/3 Ash; T5: *K. senegalensis* +1/3 Ash; T6: 1/2(*G. senegalensis* + *P. reticulatum*); T7: 1/3 (*G. senegalensis* + *P. reticulatum*; + *A. indica*); T8: *P. reticulatum* + urea; T9: *G. senegalensis* + urea; T10: *A. indica* + urea; T11: *V. paradoxa* + urea+1/3 ash; T12: *K. senegalensis* + urea+1/3 ash; T13: 1/2 (*G. senegalensis* + *P. reticulatum*)+ urea; T14: 1/3 (*G. senegalensis* + *P. reticulatum* + *A. indica*) + urea.

(Yelemou Bartelemy INERA)

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Climate resilient production systems: Agroecology for enhanced productivity, soil and livestock

Biological pest and disease control

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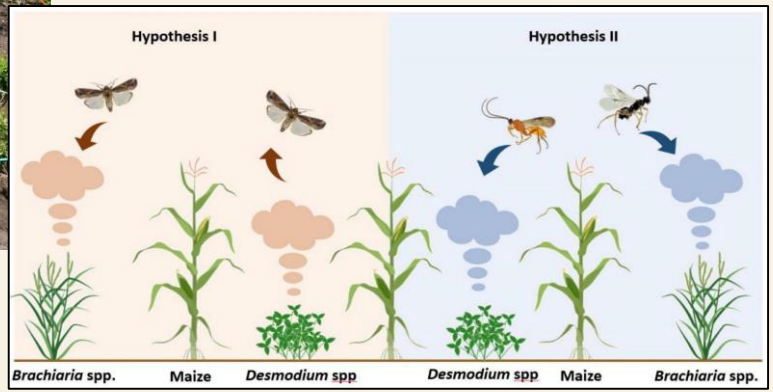
The Push-Pull Technology for African Cereals



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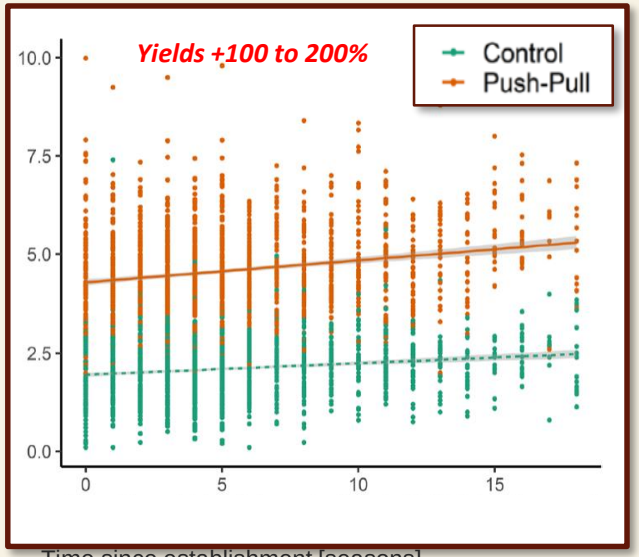
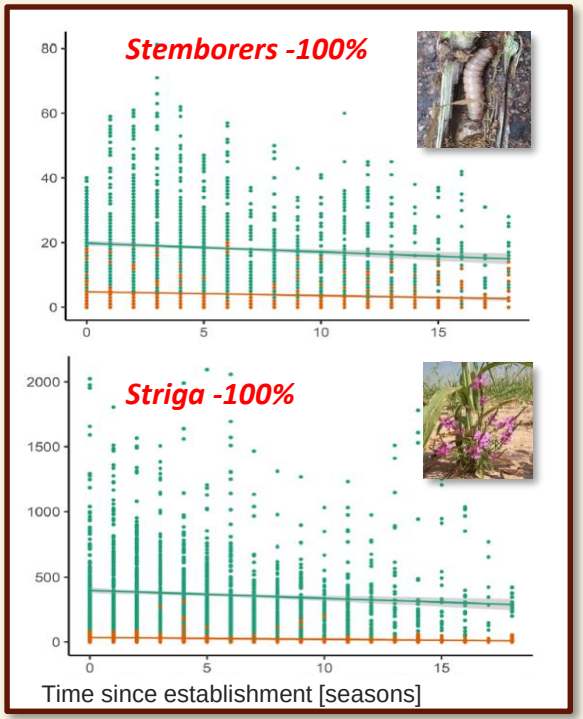
The Push-Pull Technology for African Cereals

Over 10 years of data from experimental farmers' fields





High effectiveness for sustainable pest control and yields under climate change

Luttermoser et al. (2023) AGEE

Luttermoser et al. (2023) AGEE

Concluding remarks

- Crop diversification on croplands as well as on tree-based production systems improve productivity, biodiversity and soil health
- Local sources such as shrub, tree and crop residues, as well as manure and compost improve crop productivity and soil health, reducing the reliance on expensive synthetic fertilizers
- Shrub and tree-based feed improve livestock productivity and health, while reducing the dependence on expensive feed rations and antibiotics
- High input organic systems perform similarly to high input conventional systems for crop productivity but better in terms of soil health
- Push-pull systems offer excellent alternative to expensive and harmful synthetic pesticide-based systems, while improving yields