



Investing into Soil Organic Carbon management for resilient upland farming (ISOC)

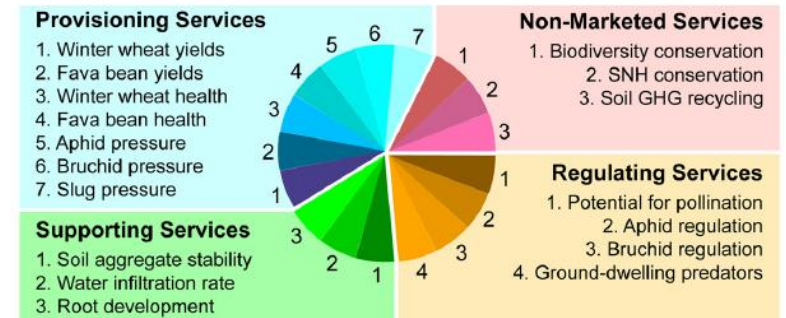
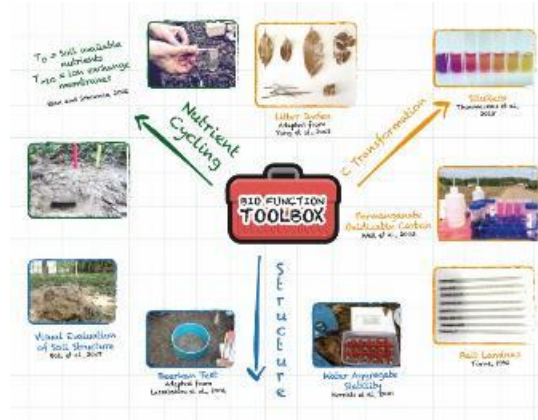
IMPACTS OF CONSERVATION AGRICULTURE ON SOIL ORGANIC CARBON AND ECOSYSTEM SERVICES IN THE UPLAND OF CAMBODIA



Battambang, CAMBODIA
Dec 01, 2021

Main activities under the PhD Study

1. Quantify the early impacts of **CA and CT** on soil organic C and N stocks (experiment)
2. Assessment of the impacts of **CT and CA** on soil microbial diversity
3. Assess the impacts of conventional plough-based management and CA-based cropping systems on Biofunctool[®] and **multiple ecosystem services** (supporting, regulating, provisioning, non-marketed services)



School & Mentoring

Graduate School: Nagoya University

First Semester Enrollment—October 2021

Mentoring & field support

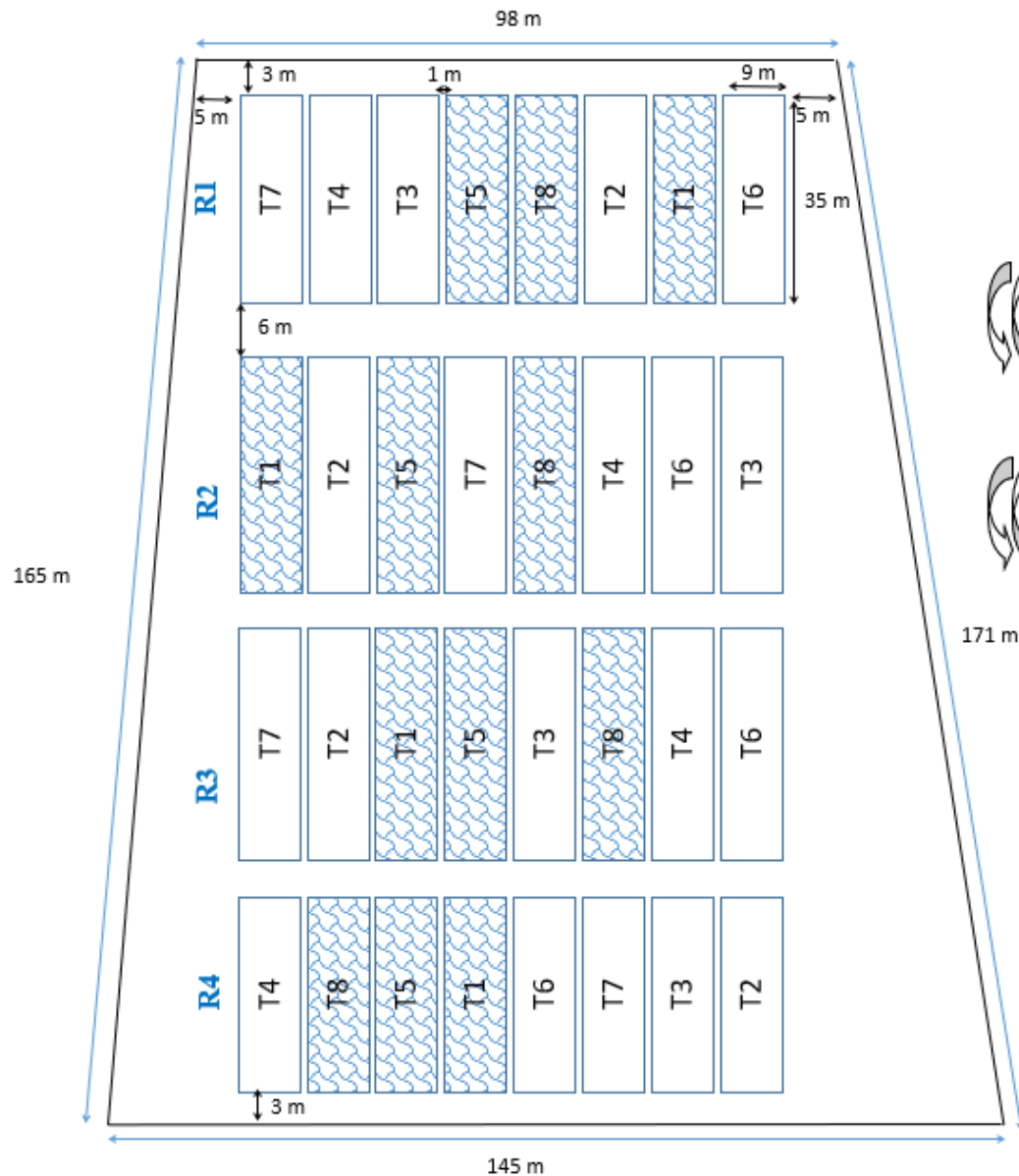
- Pr. Murase Jun, DOI Kazuyuki, NISHIUCHI Shunsaku (Microbial assessment)
- Prof. Jean-pierre Sarthou (ENSAT, Multi-services assessment), Dr. Alexis Thoumazeau (CIRAD, Biofunctool, diachronic SOC assessment)
- Dr. Seng Vang (GDA/DALRM), Dr. Srean Pao (NUBB), Dr. Hok Lyda (RUA), Mr. Sar Veng (PDAFF Pailin, CASC), Mr. Leng Vira (DALRM, CASC), Dr. Florent Tivet(CIRAD): diachronic, experiment management and on-farm support

Continuity of the study of 2020

- Collect additional samples in Borun experiment for
 - ✓ Changes in SOC fractions
 - ✓ Changes in Microbial communities
- In Farmers' paired plots in Sangha village
 - ✓ Following the trend of POXC/SutuResp[®]

Experiment: impacts of cropping systems on SOC

Path from national Road to Pailin



Protocol of the experiment at Borun Year 2 (2021)

- | | |
|------------|--|
| T1: | Conventional tillage (CT) with 2 plough + cover crop as a green manure before maize (only one cycle/year) |
| T2: | CA maize monocropping under mix cover crops. The cover crops will be established in association or as biopump depends on the rainfall from year to year. |
| T3: | Bi-annual rotation of CA cassava (2021)/maize. Green sowing maize on mix cover crops, no cover crops associated with cassava |
| T4: | Bi-annual rotation of CA maize (2021)/cassava (2022). Green sowing maize on mix cover crops, no cover crops associated with cassava |
| T5: | Bi-annual rotation of CA cassava (2021)/maize (2022). Green sowing of maize on cover crops and <i>Stylosanthes guianensis</i> associated with Cassava. |
| T6: | Bi-annual rotation of CA maize (2021)/cassava (2022). Green sowing of maize on cover crops and <i>Stylosanthes guianensis</i> associated with Cassava. |
| T7: | Permanent cover crops for mono-cropping maize (<i>Neonotonia wightii</i>) |
| T8: | Full conventional tillage-based maize monocropping as reference. |

*Pre-experiment land preparation (2020): 3 disc-plough + 2 passes of land plane leveller

*In 2021: - Mix cover crops: Juncea (15) + Pearl millet (12) + Cowpea (8)
- Single bio-pump: Juncea (25)



Experiment in Borun

1. Quantify the early impacts of CA and CT on soil organic C and N stocks (experiment)*

- ✓ Soil Baseline have taken in May 2020
- ✓ Second time soil sampling: 07 June, 2021
 - Depths: 0-5cm, 5-10cm, 10-20cm, 20-40cm
 - Five sampling points to make one composite sample
 - Air-dried, homogenized and sieved 2.0mm
 - Crushed and sieved 0.5mm for C/N analysis
 - **Further preparation for SOC fractions**
 - ✓ **Physical fractions**
 - **C-Clay**
 - **C-Silt+Sand**



Experiment in Borun

2. Assessment of the impacts of CT and CA on soil microbial diversity

- Taken on 07 June, 2021
- Depths: 0-5cm, 5-10cm (64 samples)
 - Depths of 10-20cm and 20-40cm (**reserved for further decision**)
- Five sampling points to make one composite sample
 - Sieved 2mm, weighed about 20g and put in 15ml falcon tube
 - Put in cool box with ice
 - Transferred to RUA, NU lab and freeze at -20°C
 - Keep for DNA extraction and analysis in NU



Experiment in Borun

1. Borun Experiment

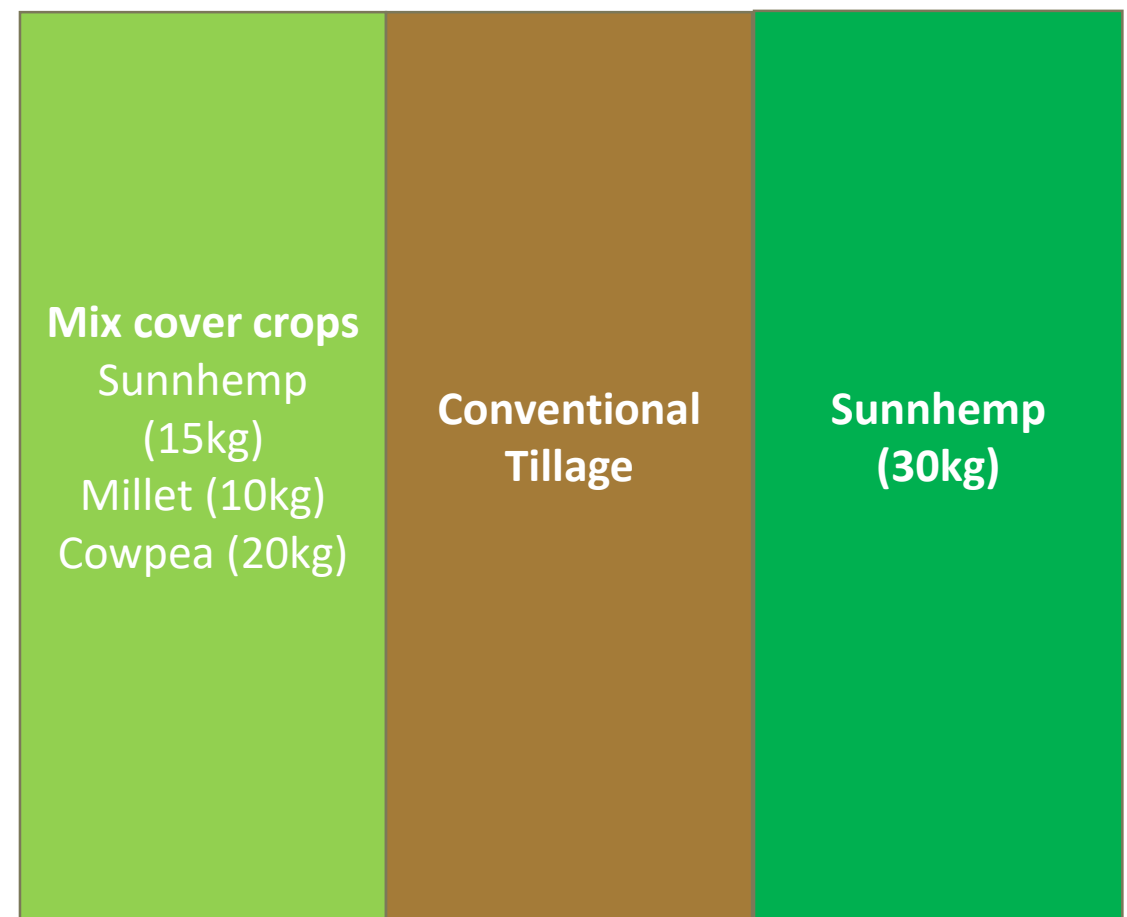
- ❑ Taken cover crops biomass prior to sowing on 08 July, 2021
- ❑ *Cover crops rolling and planting maize on 12 July, 2021*
- ❑ *There is no rain ever since sowing until Mid-August*
- ❑ *Resowing on 20th Aug, 2021*
- ❑ *First Harvest 1st 2nd Nov, 2021*



Paired-plots

3. Biofunctool® assessment

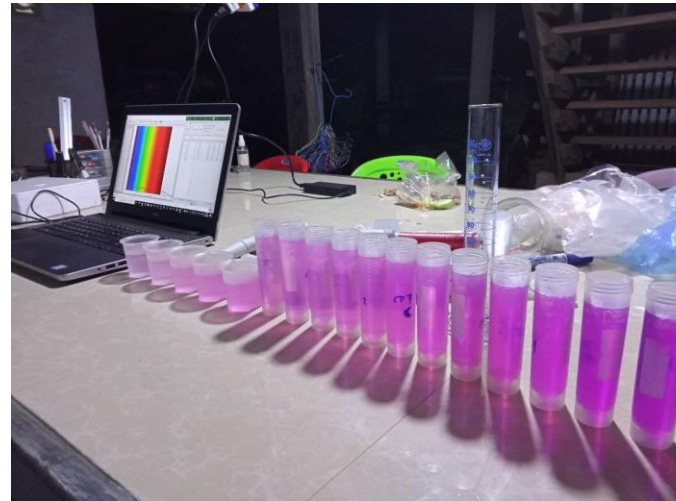
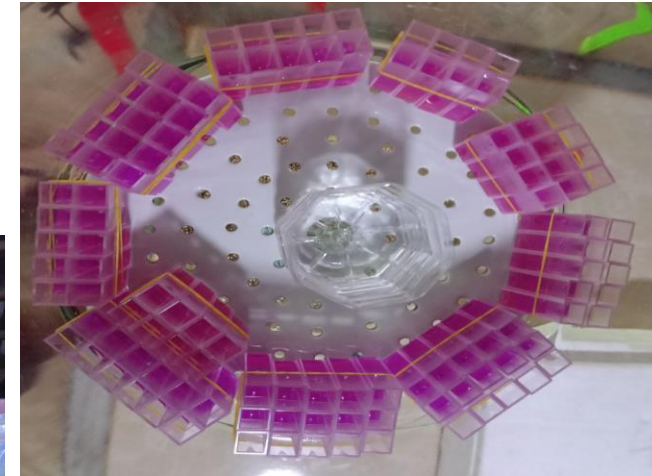
- Location; Farmer fields (6 farms) in Sangha village
- Five sampling points to make one composite sample
- Sieved 5mm, weighed 100g put in the tightly sealed jar
- Measure SituResp®
- **Remaining samples were air-dried for POXC assessment**



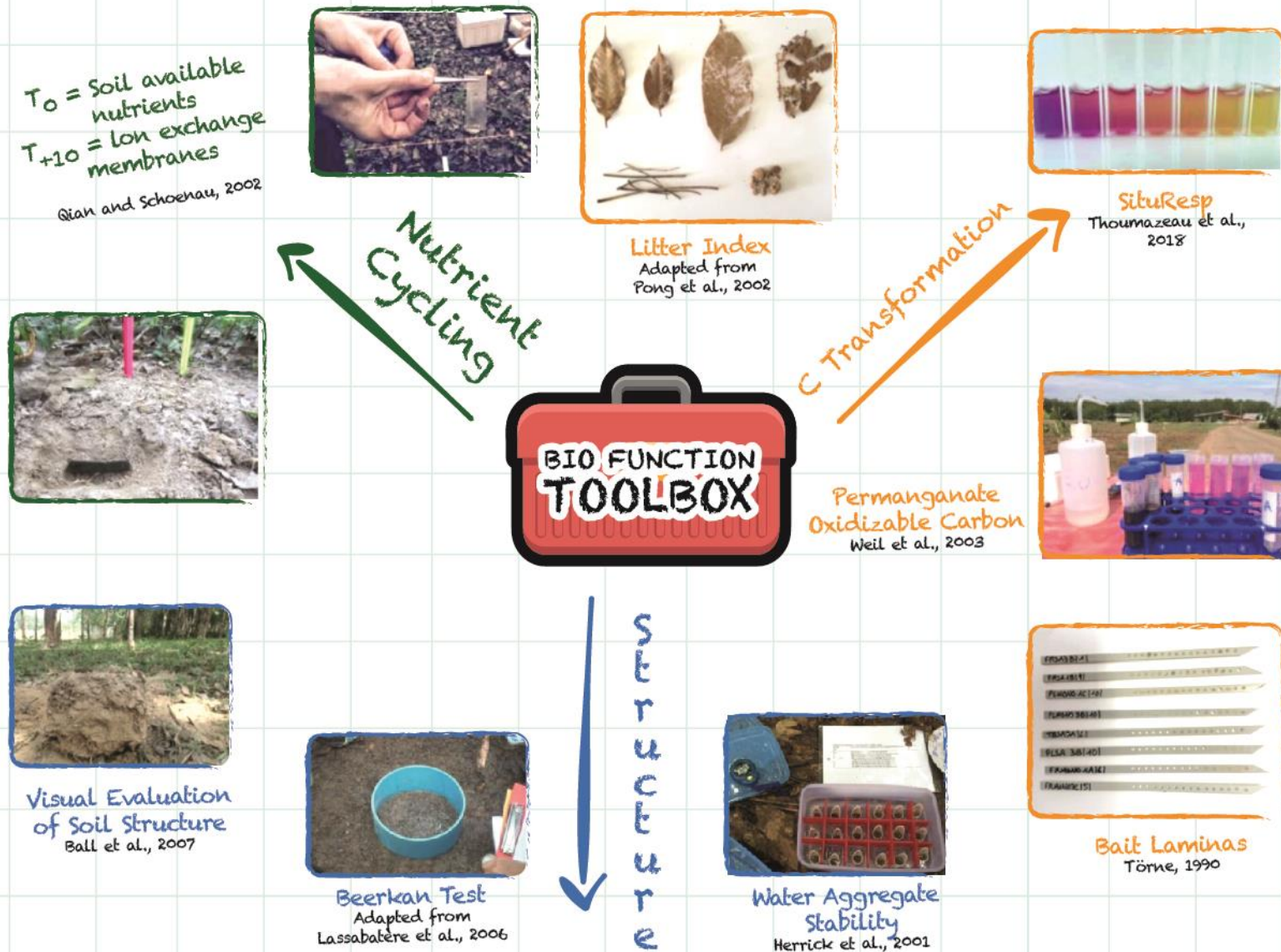
Paired-plots

3. Biofunctool® assessment in 2021

- 08 June—cover crops are 28 days old
- July 10—before rolling cover crops and sowing maize
- 25 Aug—42 days after rolling
- 14 Sep—60 days after rolling
- 14 Oct—90 days after rolling
- Nov 26 After harvest first maize
 - Full **Biofunctool**® assessment



ASSESSMENT OF SOIL HEALTH - BIOFUNCTOOL®



3 main soil functions with : (1) Soil C transformation, (2) Soil structure maintenance and (3) Nutrient cycling.

Biofunctool has been validated under annual crops through the project EISOFUN/CCCA (DALRM, GDA)

Biofunctool®

1. Carbon transformation

- POXC
- SituResp®
- Lamina Bait
- Biomass before rolling and remaining after harvest

1. Nutrient Cycling

- Nitrate and ammonium (4 replications per sample)
- Available P (Olsen)
- Exchangeable K, Ca, Mg, Na

2. Structure maintainance

- VESS
- Slack test (aggregate stability) of 0-5cm, 5-10cm
- Beerkan

Additional Analysis

- Bulk Density
- pH
- EC
- Total N
- SOC

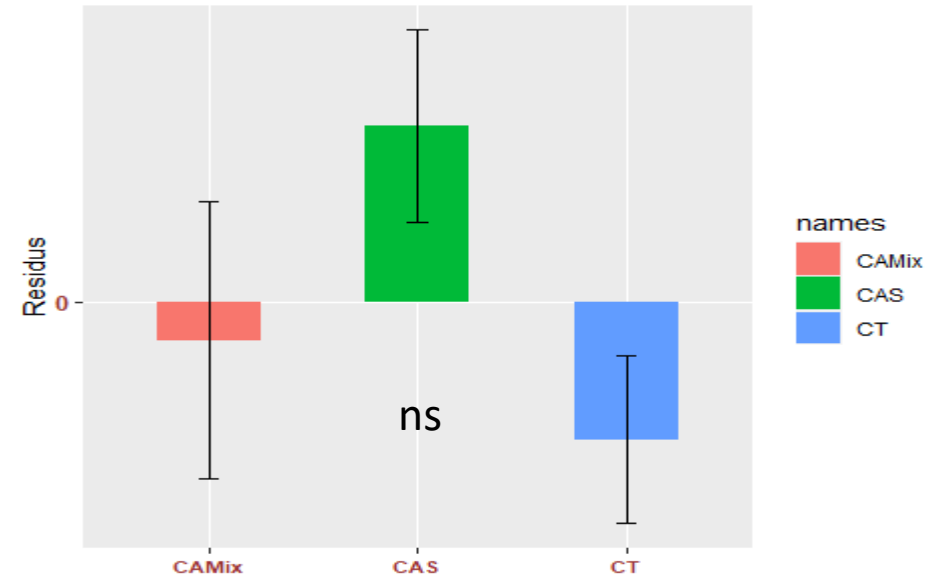
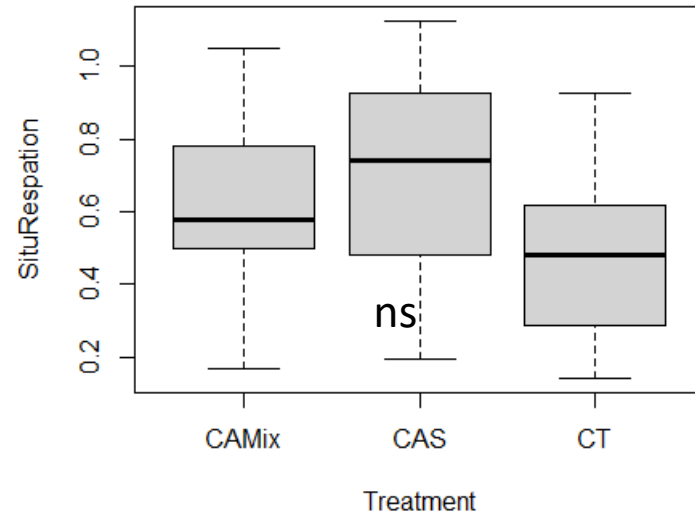
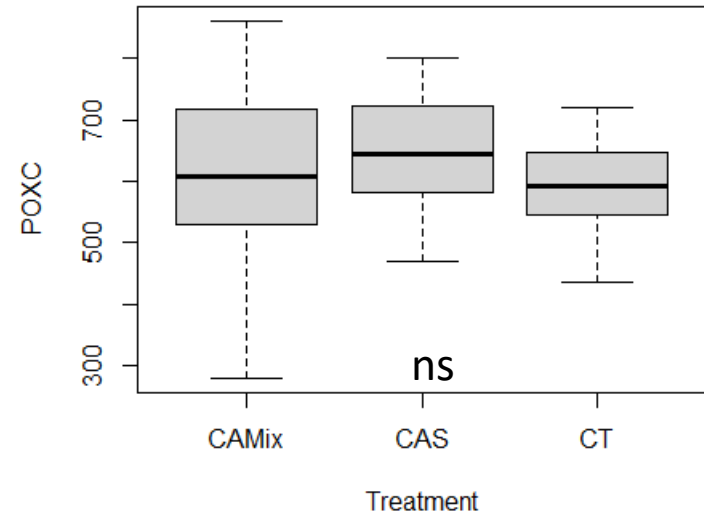
Soil Composites

In addition to Biofunctool[®], we will take composite samples in the pair-plots

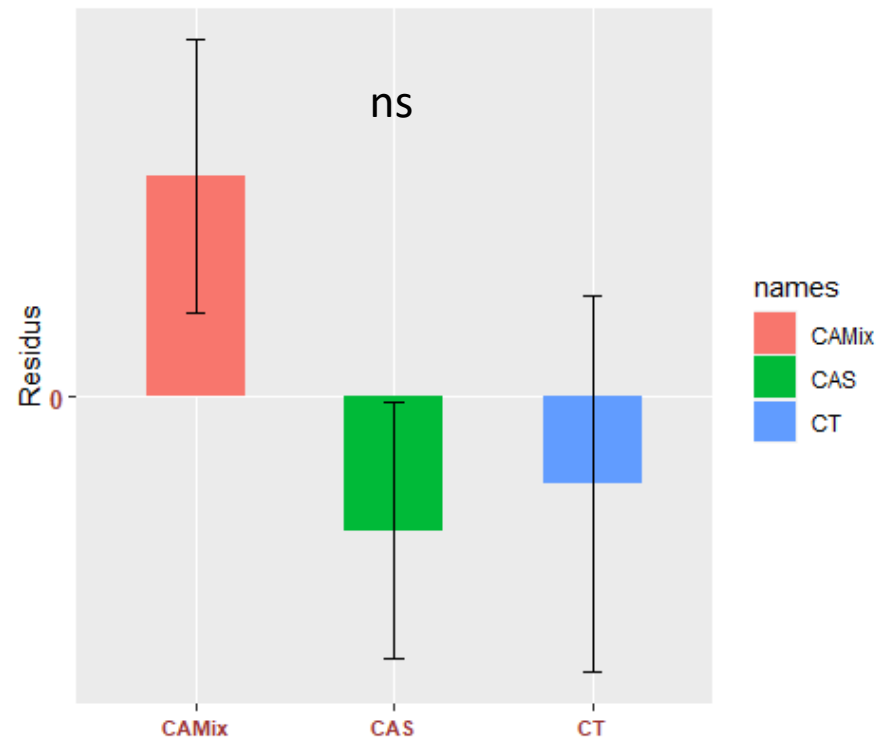
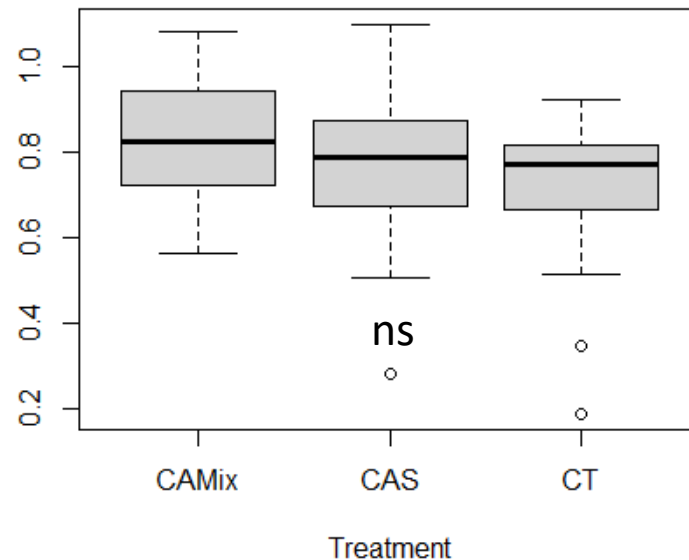
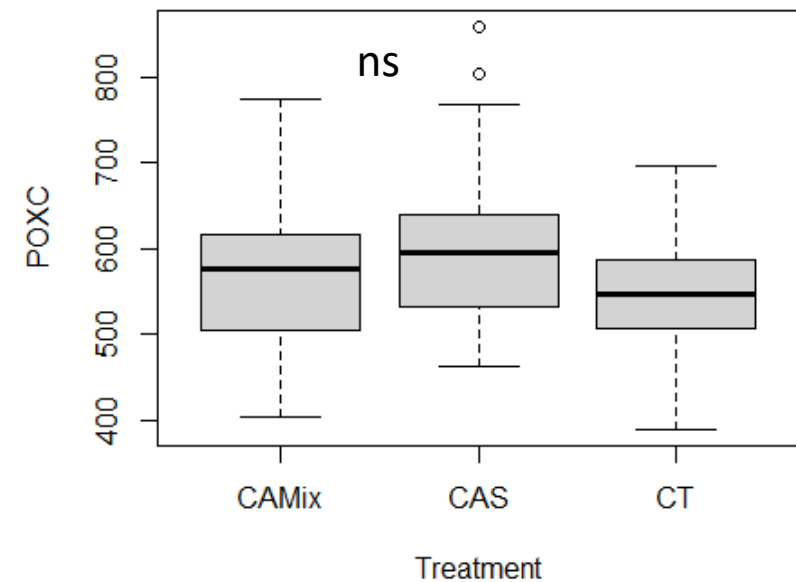
- 0-5cm and 5-10cm
- 10-20cm
- 20-30cm
- 30-40cm

Totally we will have 450 samples and bulk densities

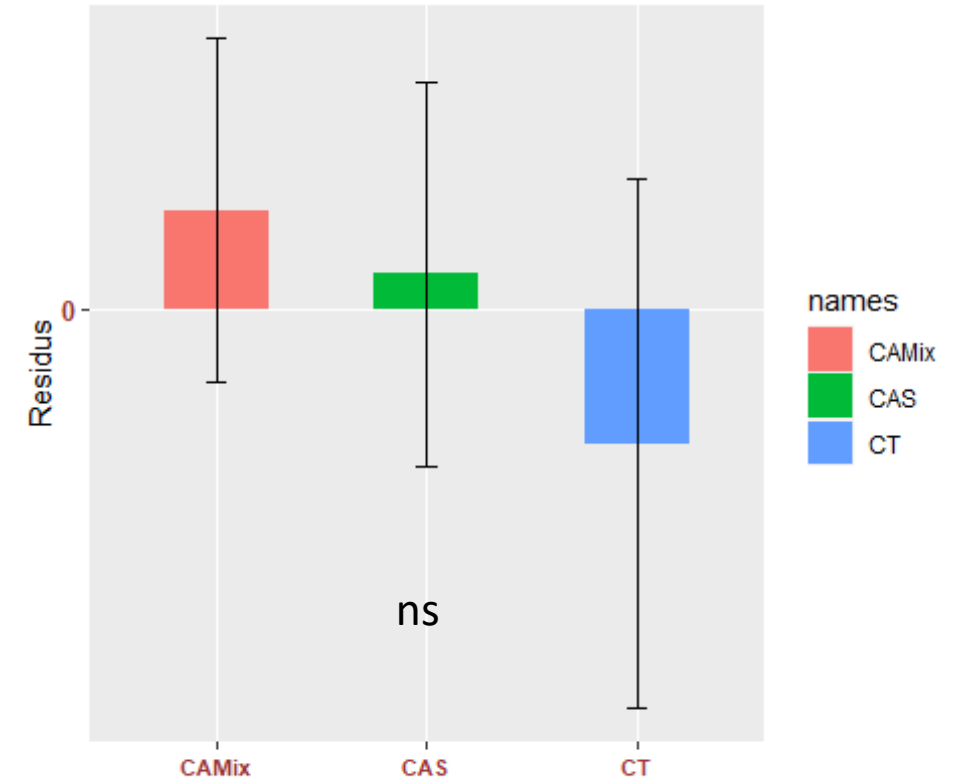
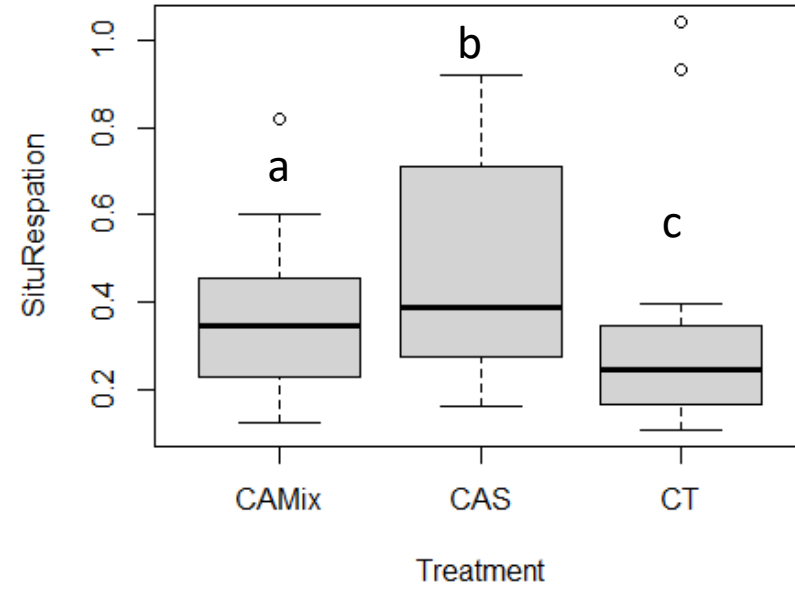
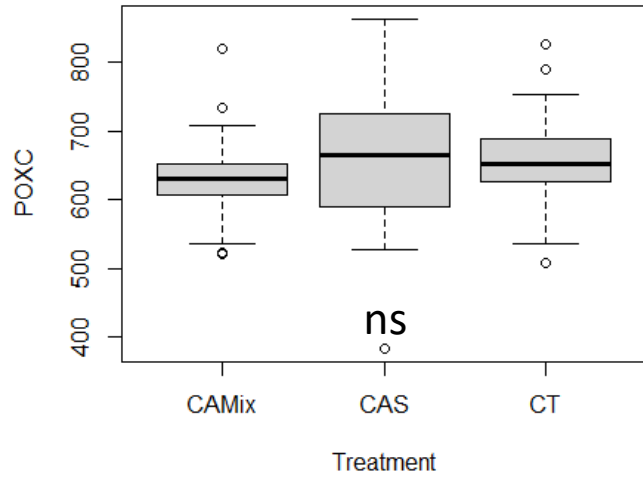
POXC vs SituResp[®] on June 8, 2021 (Cover crops are 28 days old)



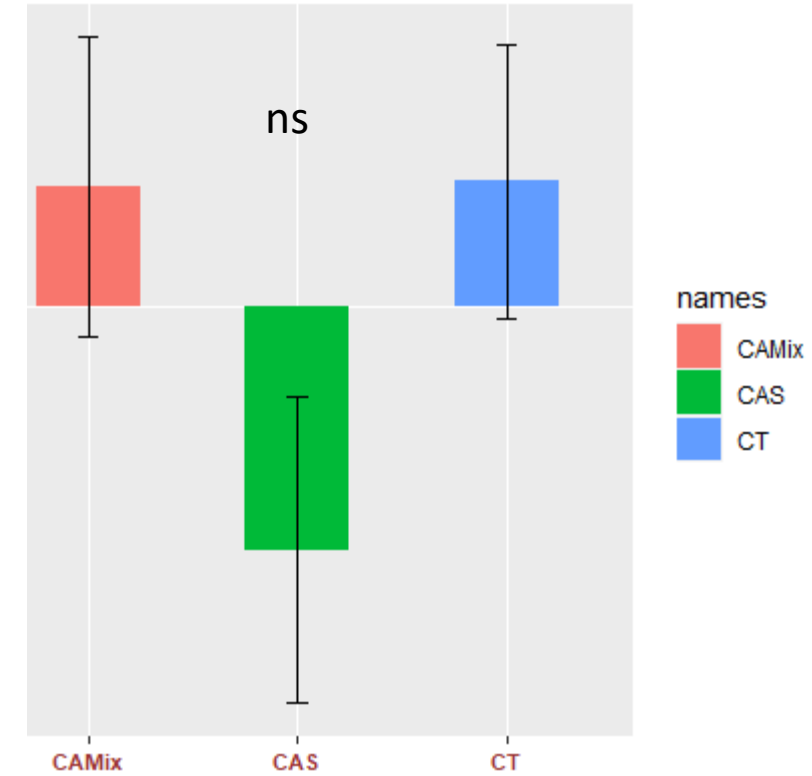
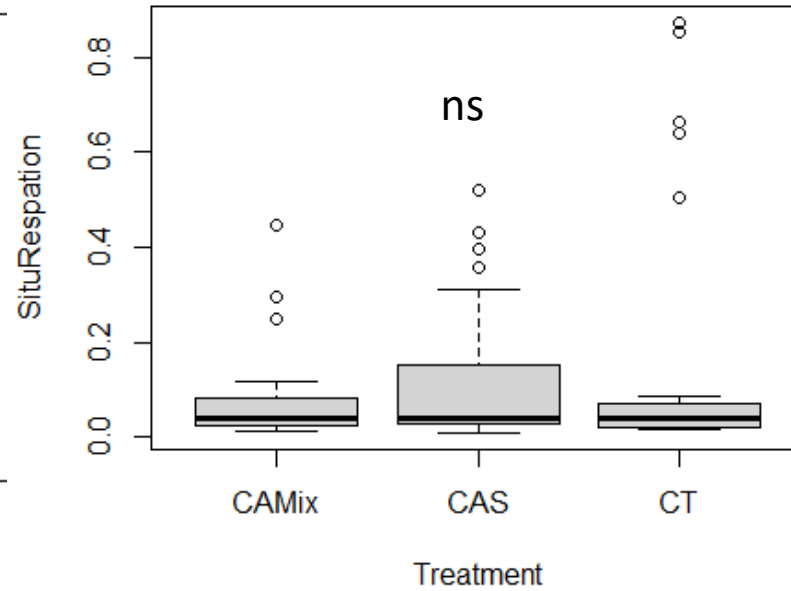
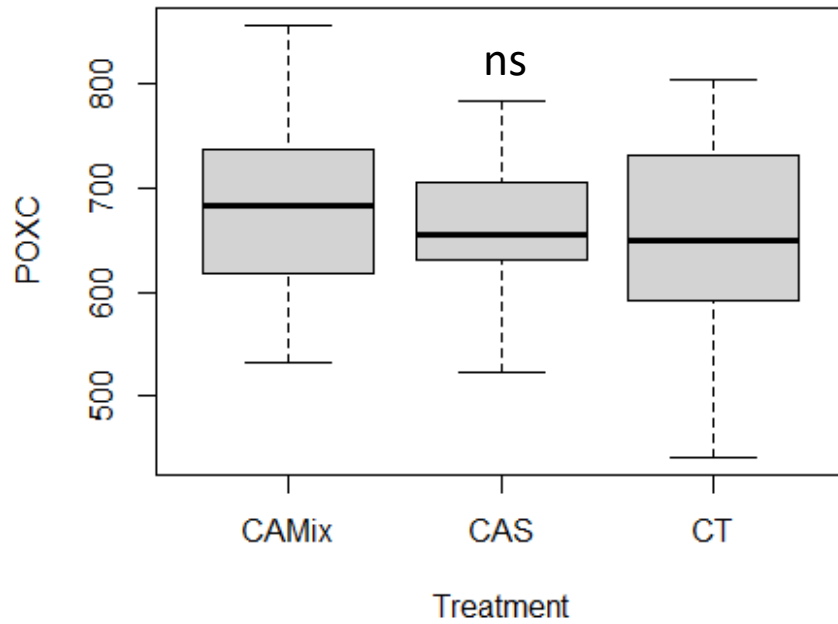
POXC vs SituResp® on July 10, 2021 (Before cover crop rolling)



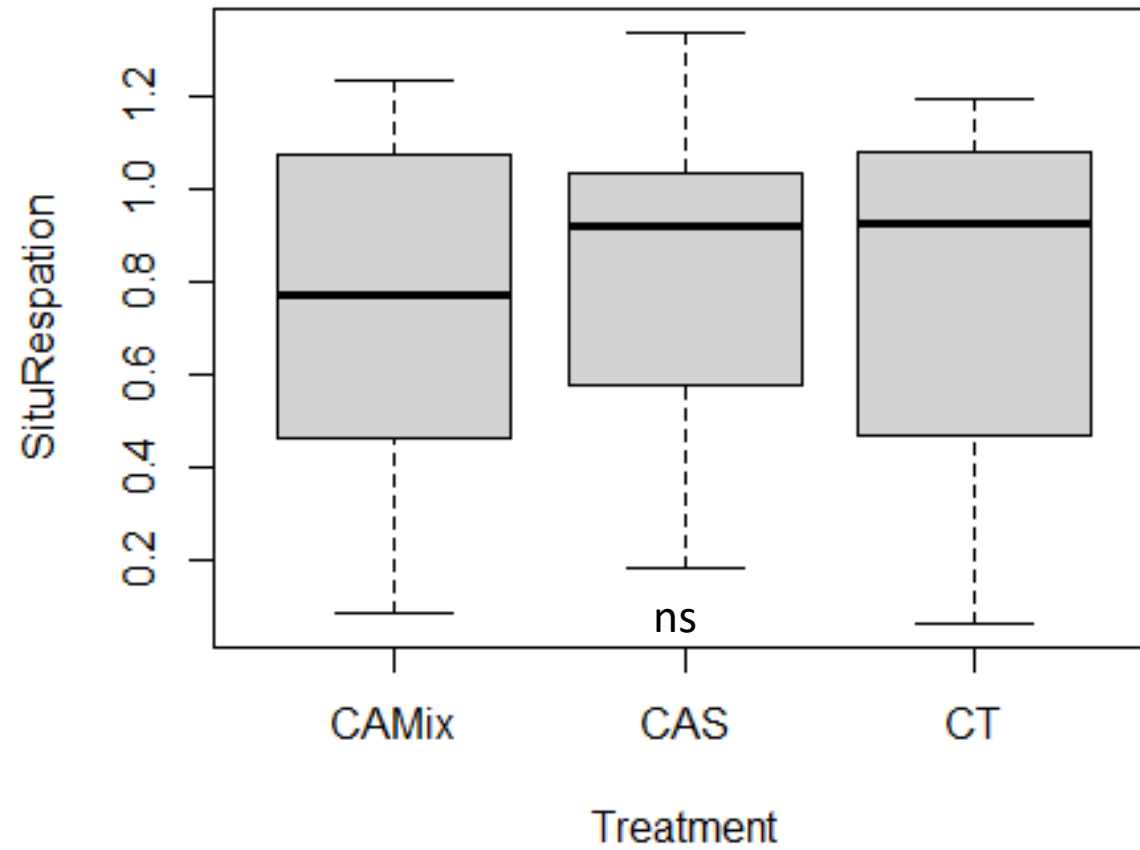
POXC vs SituResp[®] after rolling cover crop for 42 days



POXC vs SituResp[®] after rolling cover crop for 60 days



SituResp[®] after 90 days of rolling cover crop



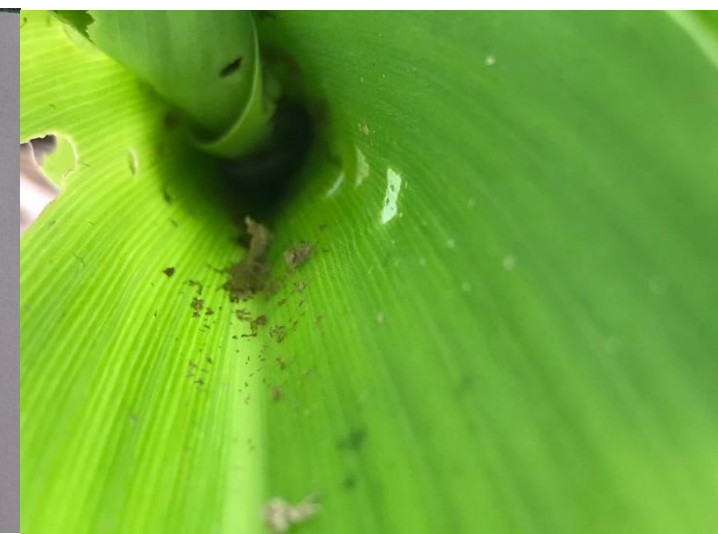
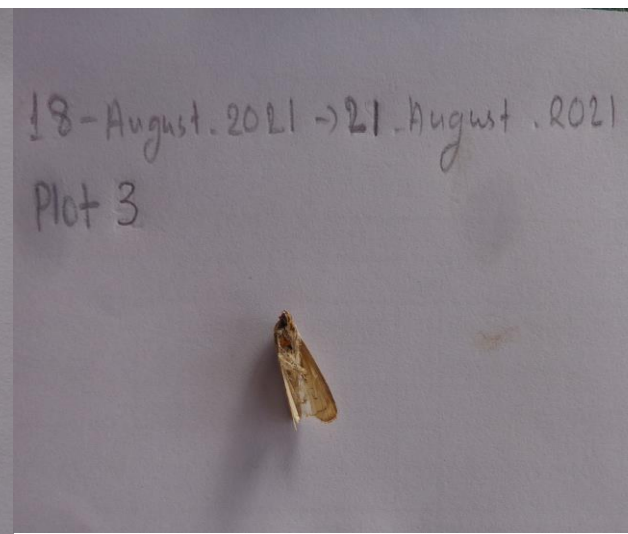
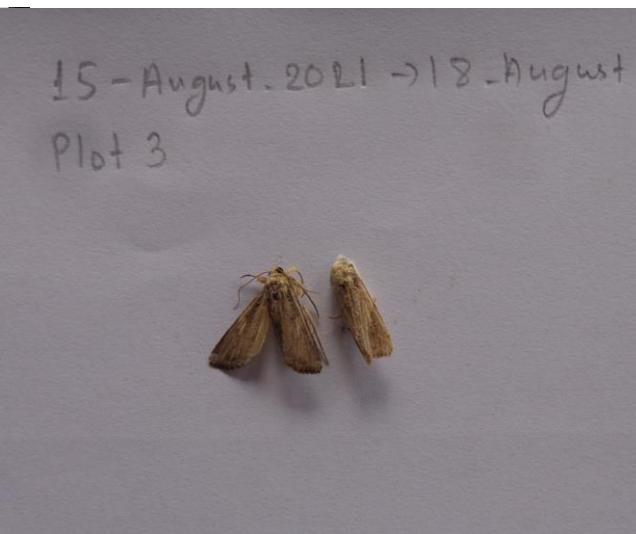
Average value of SituResp[®] and POXC

	SituResp1	SituResp2	SituResp3	SituResp4	SituResp5	POXC1	POXC2	POXC3	POXC4
CT	0.49	0.72	0.30	0.04	0.68	591.90	531.86	644.20	604.99
CAS	0.71	0.78	0.48	0.23	0.83	655.52	602.69	651.40	702.93
CAMix	0.63	0.83	0.36	0.06	0.85	619.36	567.33	651.99	685.37

4. Multiple ecosystem services assessment

☐ multiple ecosystem services

- Installing **FAW trapping** in Sangha farmer fields (01 July, 2021)
- Counting *Spodoptera frugiperda* population
- Checking damage of FAW on maize at 14 DAS, 28 DAS, 42 DAS



FAW population observation from 01 July to 24 Aug, 2021

	1-3 July	3-5 July	5-7 July	7-9 July	9-12 July	12-15 July	15-17 July	17-20 July	20-23 July	23-26 July	26-28 July	28-31 July	1-3 Aug	3-6 Aug	6-9 Aug	9-12 Aug	12-15 Aug	15-18 Aug	18-21 Aug	21-24 Aug
Plot1	1	0	4	1	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0
Plot2	0	0	0	0	1	1	2	2	0	6	0	0	0	0	1	0	0	1	0	0
Plot3	1	0	1	0	2	1	0	9	0	19	8	0	0	0	2	0	0	2	0	0
Plot4	2	1	3	1	3	0	0	0	1	8	0	0	0	0	1	0	0	1	0	0
Plot5	5	4	3	0	1	0	1	0	1	9	1	0	0	0	1	0	0	0	0	0
Plot6	0	0	1	3	1	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0

Planning	Date
Finish field works (Agronomic assessment, Biofunctool)	Nov-Dec 2021
Analysis of Biofunctool samples (Ammonium, nitrate...)	
Extracting Soil for Microbial assessment	Dec 2021-Jan 2022
Meeting with Dr. Alexis	
Meeting with Prof. Jean Pierre	Feb 2022
Going to NU	Feb-Mar 2022
May, 2022	Third sampling

Thank you