R&D Strategic Flow

R&D THEMES

Climate & Weather Smart Plant Nutrition

Precision Nutrient Management

Soil Heath for Improved Livelihoods

FLAGSHIP INIATIVES

Creating 4R Knowledge in Food Crop Systems

Increasing Income in Agroforestry Landscapes

Resilient Agriculture for African Drylands (RAFAD)

Excellence in Crop Nutrition Research & Outreach

APNI Graduate Research Program

Connections for a Growing Africa

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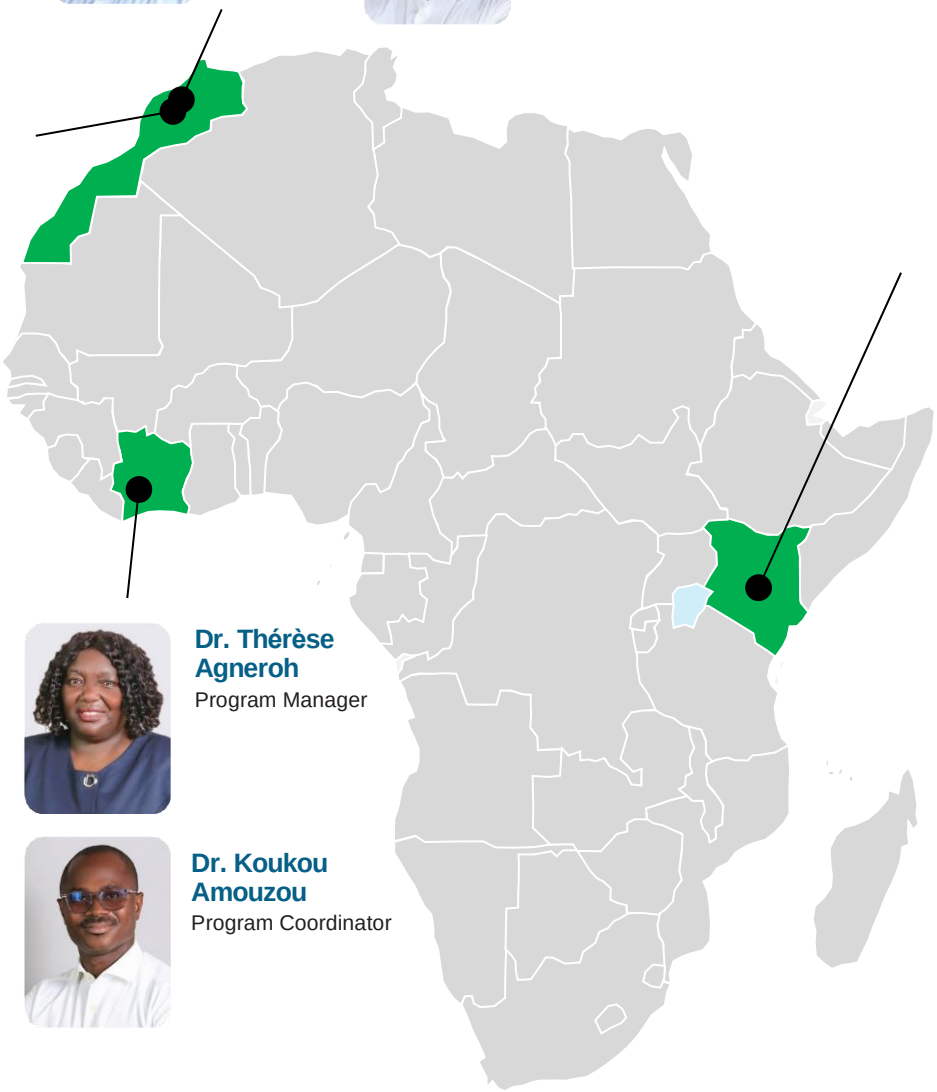

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AFRICAN PLANT NUTRITION INSTITUTE

Monitoring of Biomass and Carbon Sequestration in SAREP

2nd SAREP Conference
Oberthür & Mutegi

Birkenfeld, Germany
10th of July 2024

Carbon Credit Market Requirements

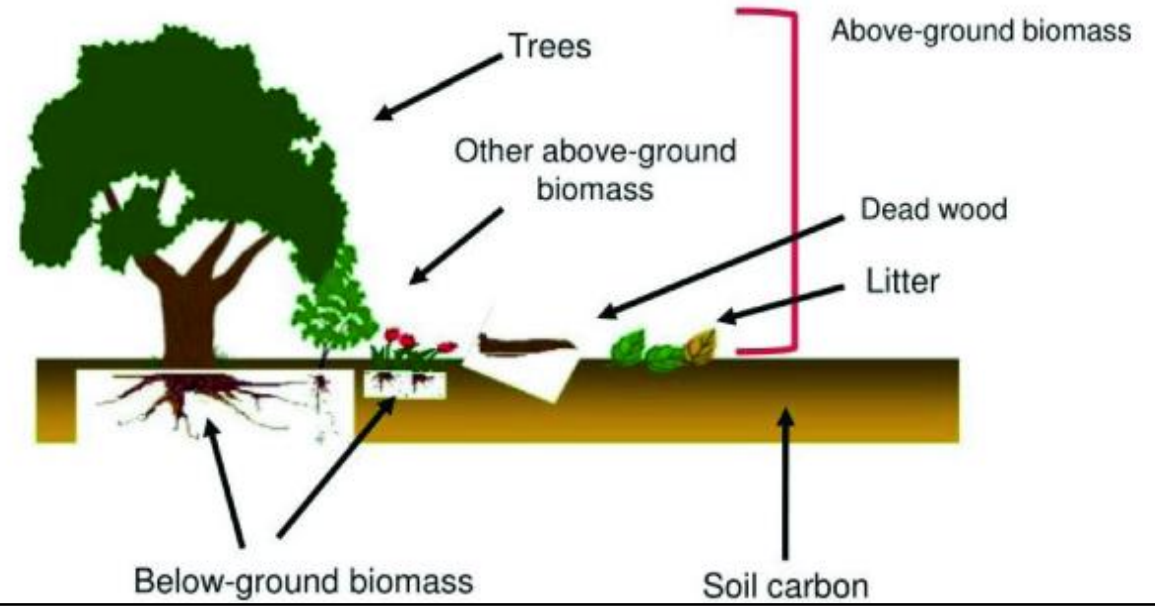
https://icvcm.org/core-carbon-principles/

EMISSIONS IMPACT

5. Additionality
6. Permanence
7. Robust measures
8. Correct measures

Carbon Credit Market Requirements

- The IPCC GPG (2003) - five carbon pools:
  aboveground biomass, belowground biomass, litter, dead wood, and soil organic carbon



EMISSIONS IMPACT

5. Additionality
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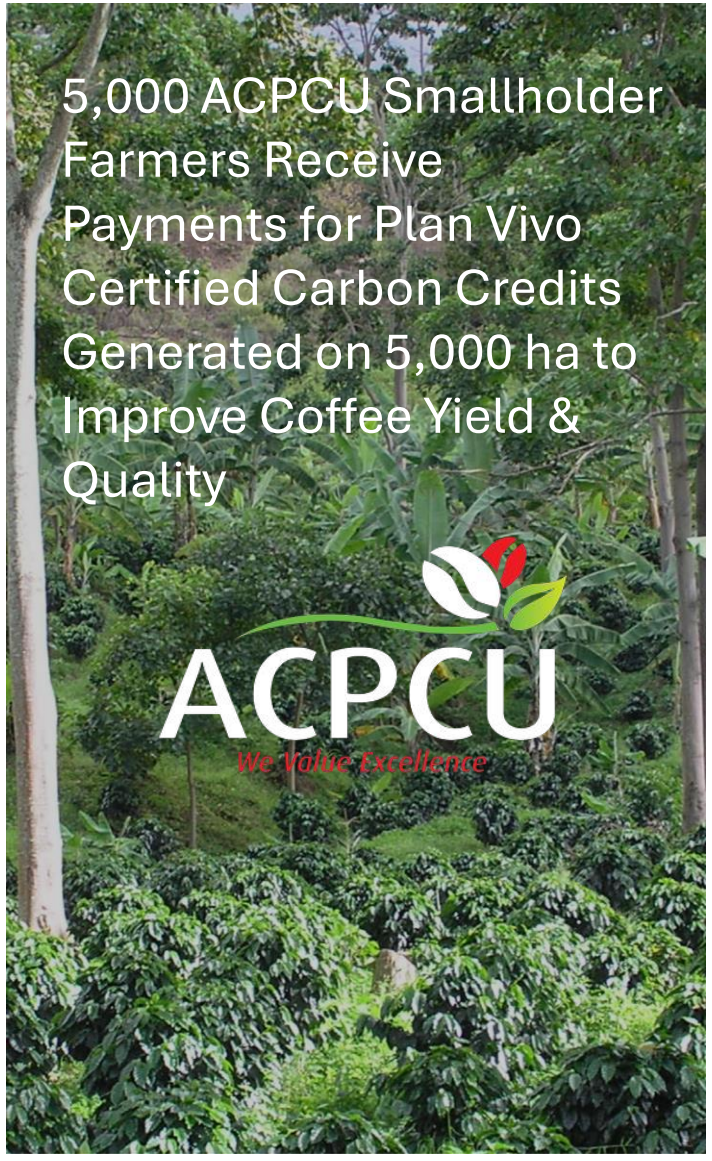
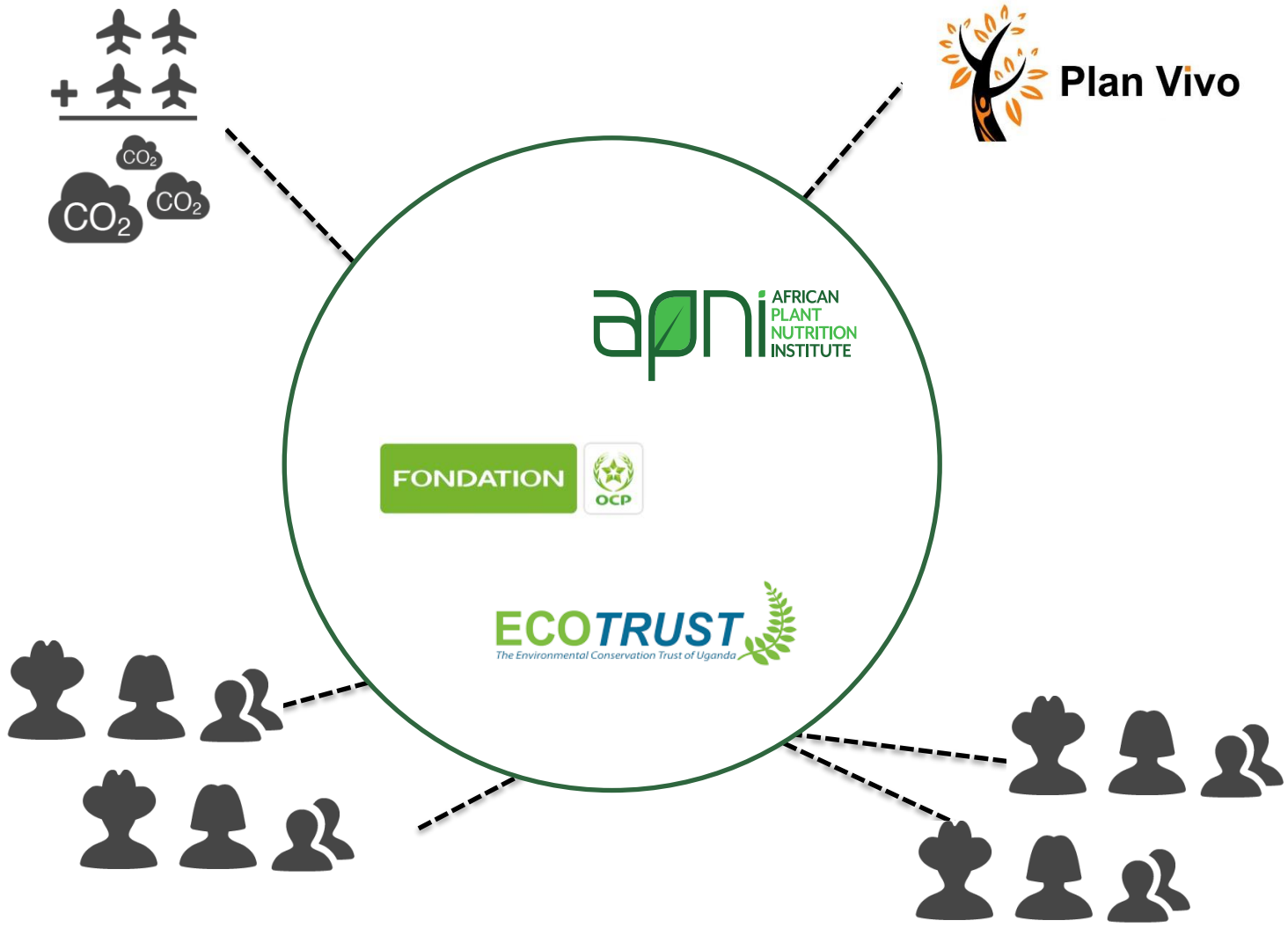
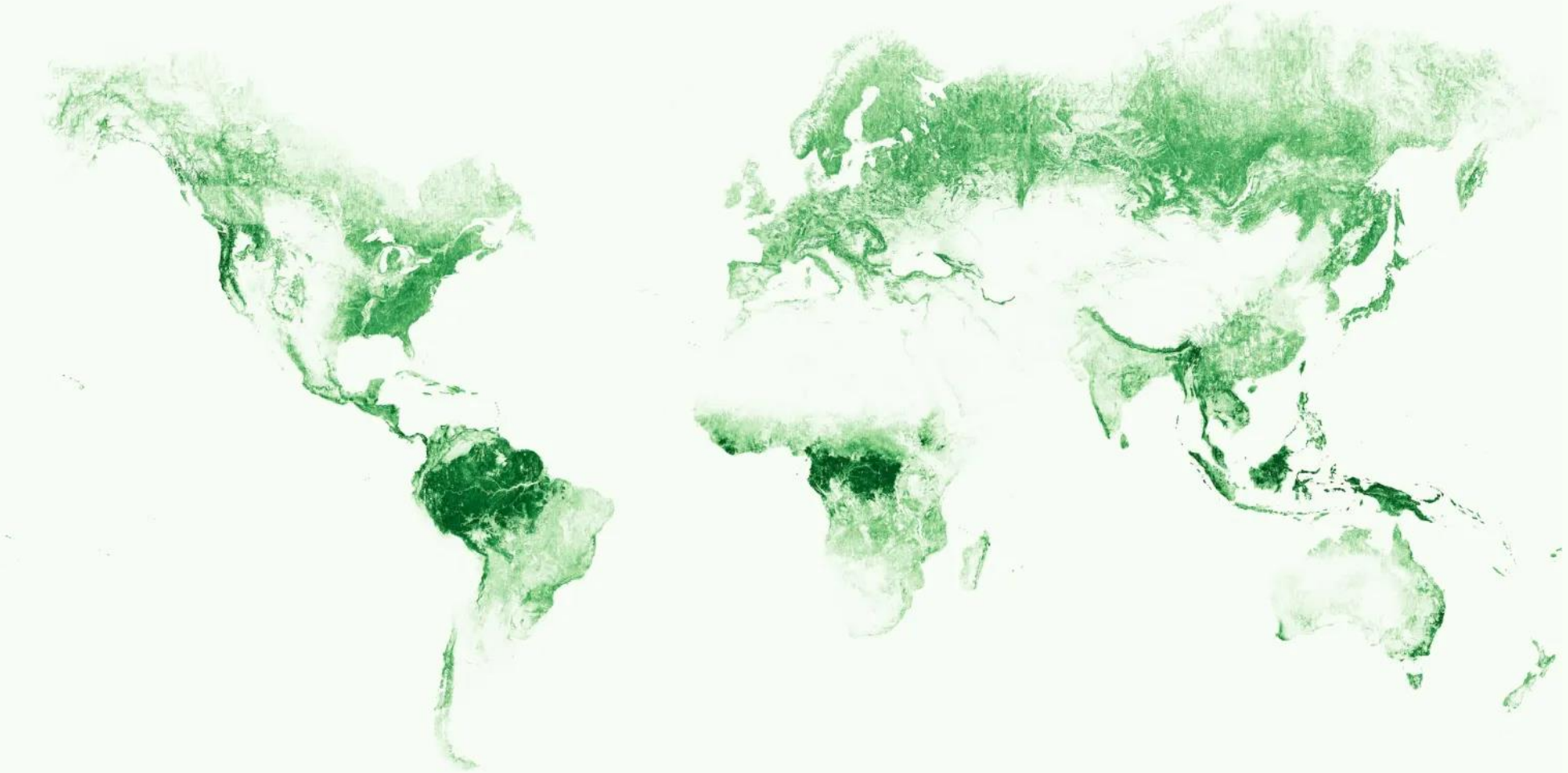
Above Ground Monitoring Protocols Established



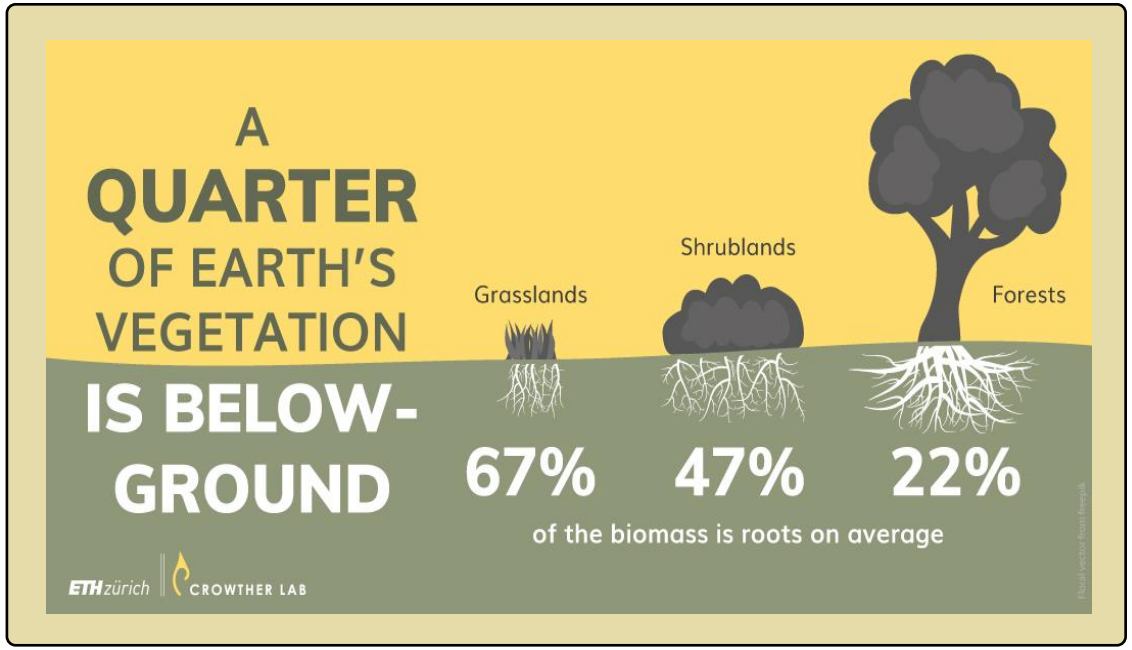


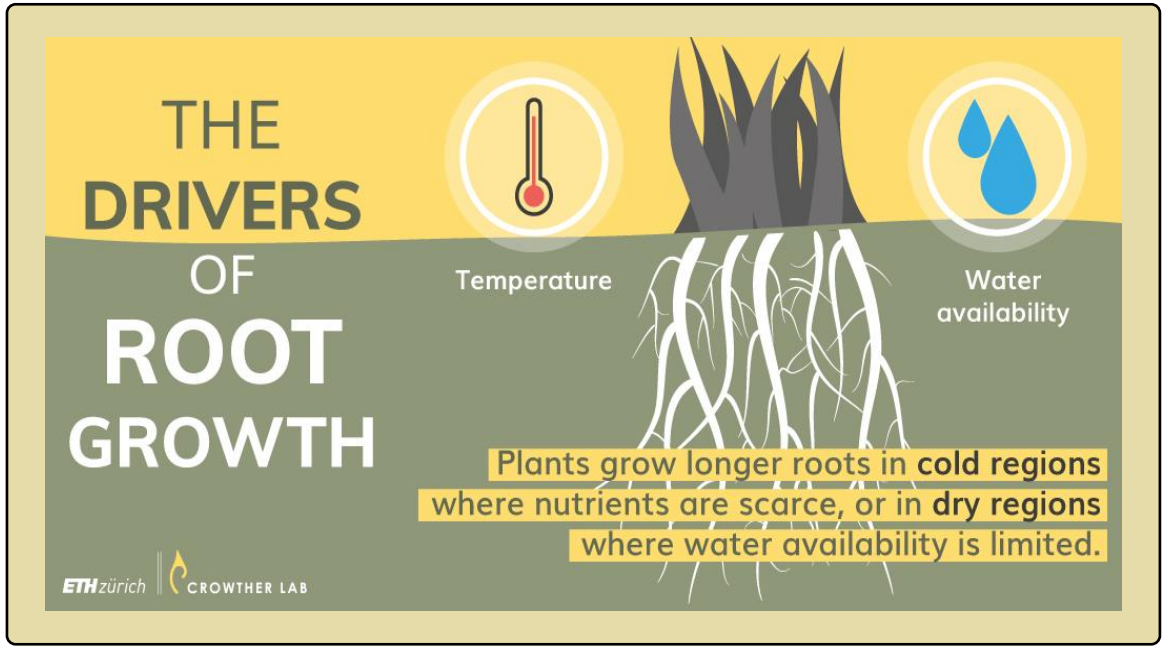
Above Ground Monitoring Protocols Established



Tolan et al. 2024. Very high resolution canopy height maps from RGB imagery using self-supervised vision transformer and convolutional decoder trained on aerial lidar. Remote Sensing of Environment, Vol 300, 113888.c

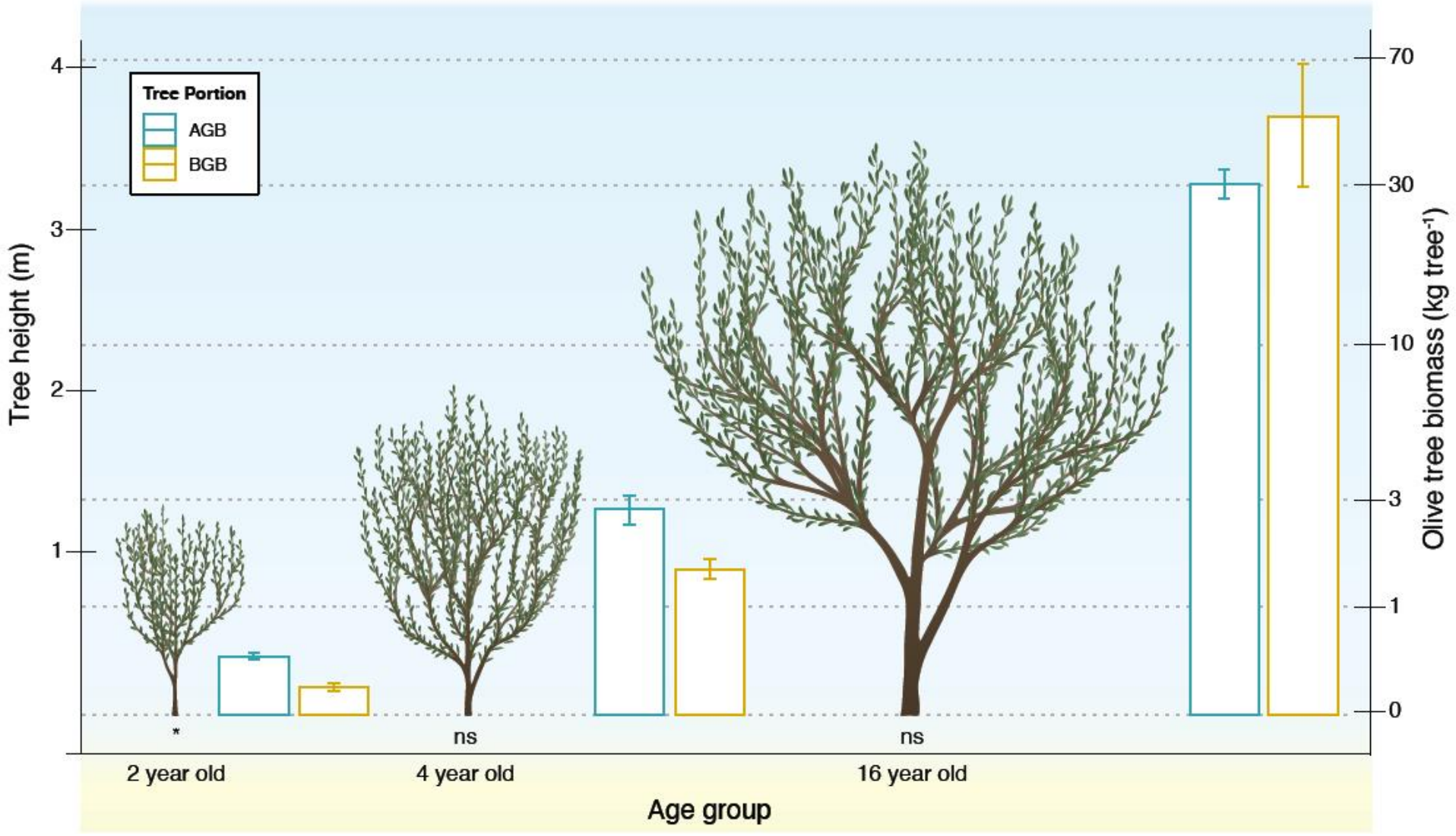
Below Ground (BG) Opportunity vs Knowledge





Ma H *et al*. 2021. The global distribution and environmental drivers of aboveground versus belowground plant biomass. Nat Ecol Evol. Doi: external page10.1038/s41559-021-01485-1

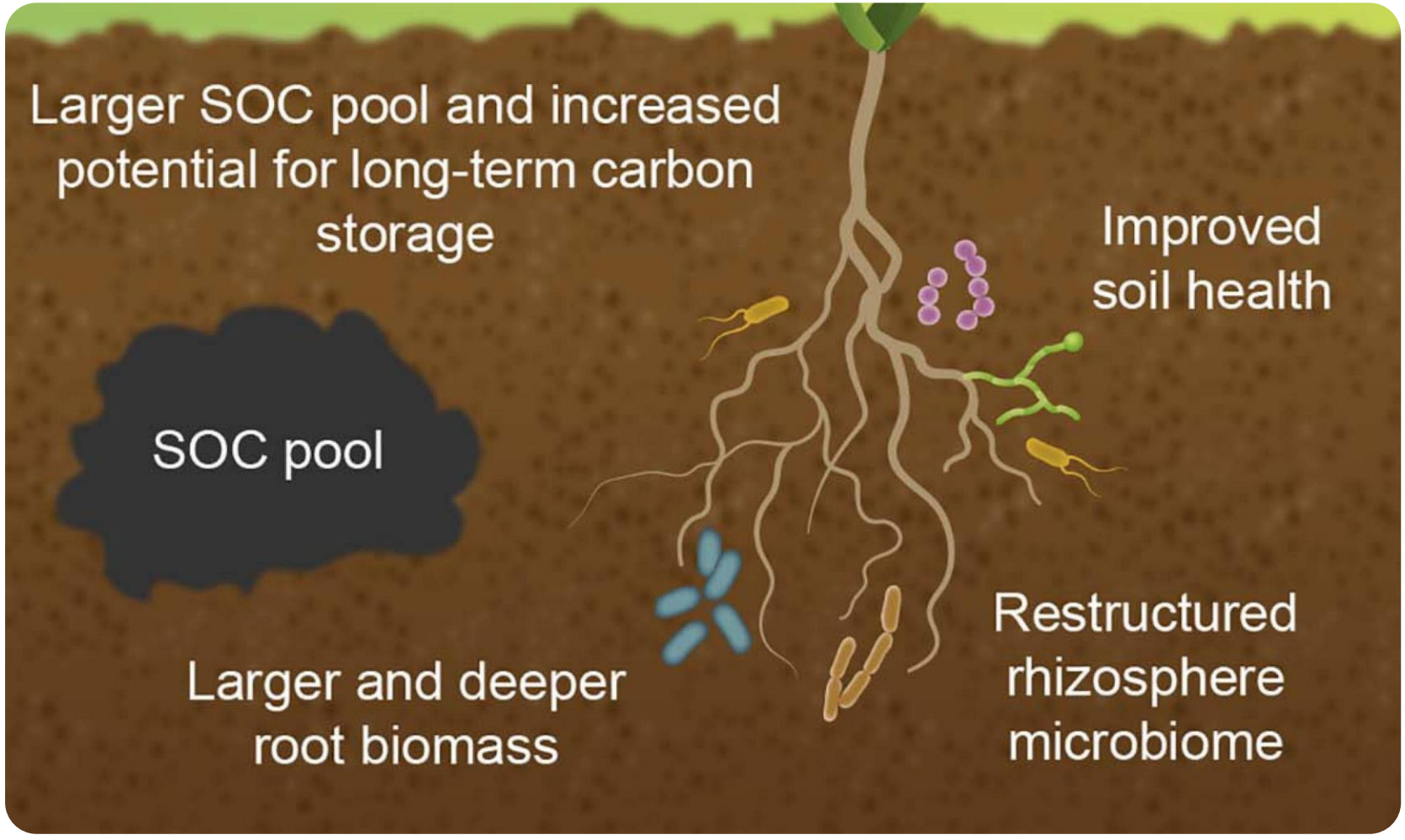
Below Ground (BG) Opportunity vs Knowledge



APNI Internal Data.
Not yet published.

BG Biomass Monitoring Goal

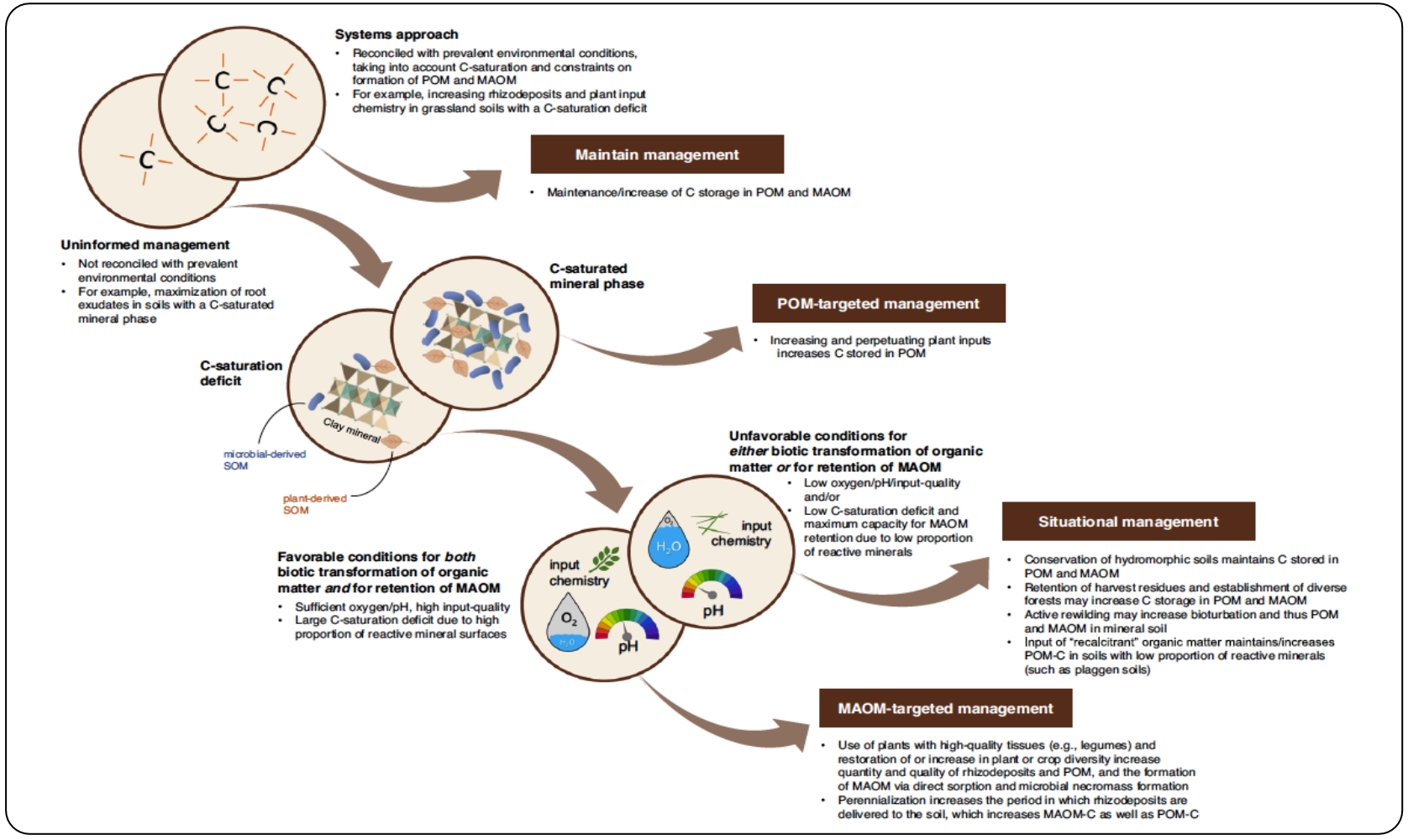
Goal of our monitoring must be to quantify BG Carbon change in a credible manner acceptable by carbon markets:



Adapted from Jansson C et al. 2021. Crops for Carbon Farming. Front. Plant Sci. 12:636709.

BG Biomass Monitoring Objectives

Objective of our monitoring is to maximize BG Carbon pool's potential for participation in global carbon markets:



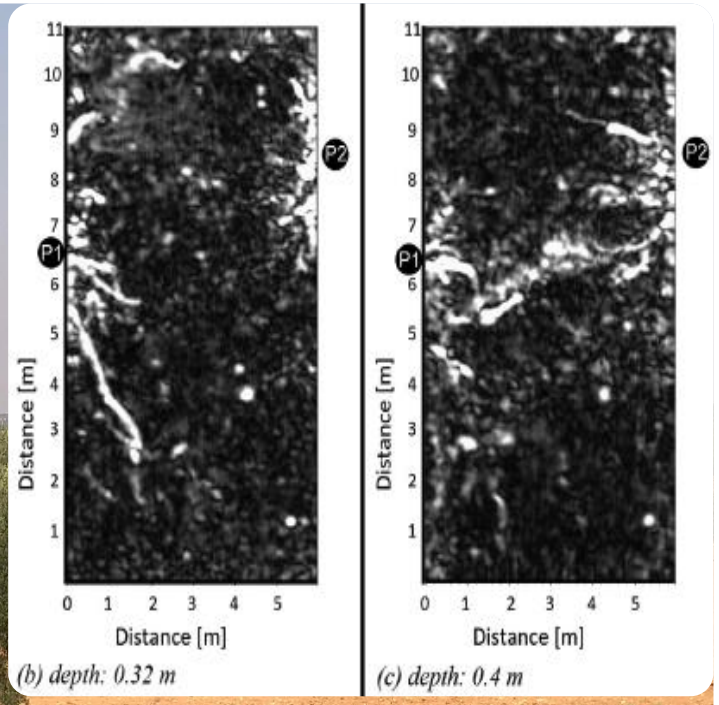
Angst *et al.* 2023. Unlocking complex soil systems as carbon sinks: multi-pool management as the key. *Nat Commun* **14**, 2967

BG Biomass Monitoring Activities

Tasks of our monitoring therefore include to review, identify, adapt and deploy analytics:

- total SOC over time, space and depth
- stable MAOM and labile POC fractions
- micro-organisms as carbon source/sink
- roots as carbon source/sink
- GHG dynamics at field scale
- impact of nutrient mgt on the above
- in addition: **calibrate** remotely sensed above ground biomass

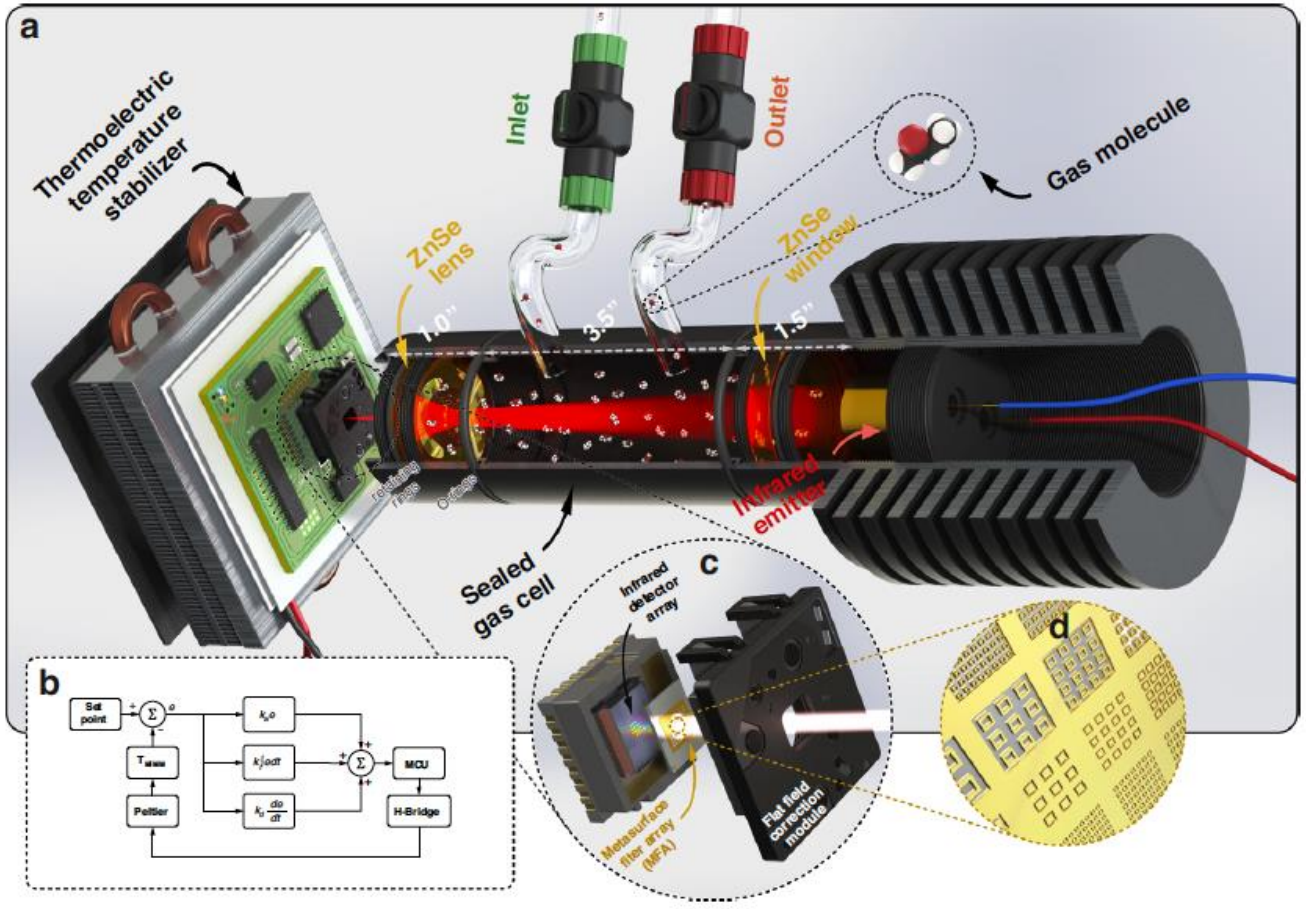
Combining Gold Standards and Innovation



Hugenschmidt and Kay. 2023. Unmasking adaption of tree root structure in agroforestry Systems in Switzerland using GPR. Geoderma Regional. Vol 34, e00659.

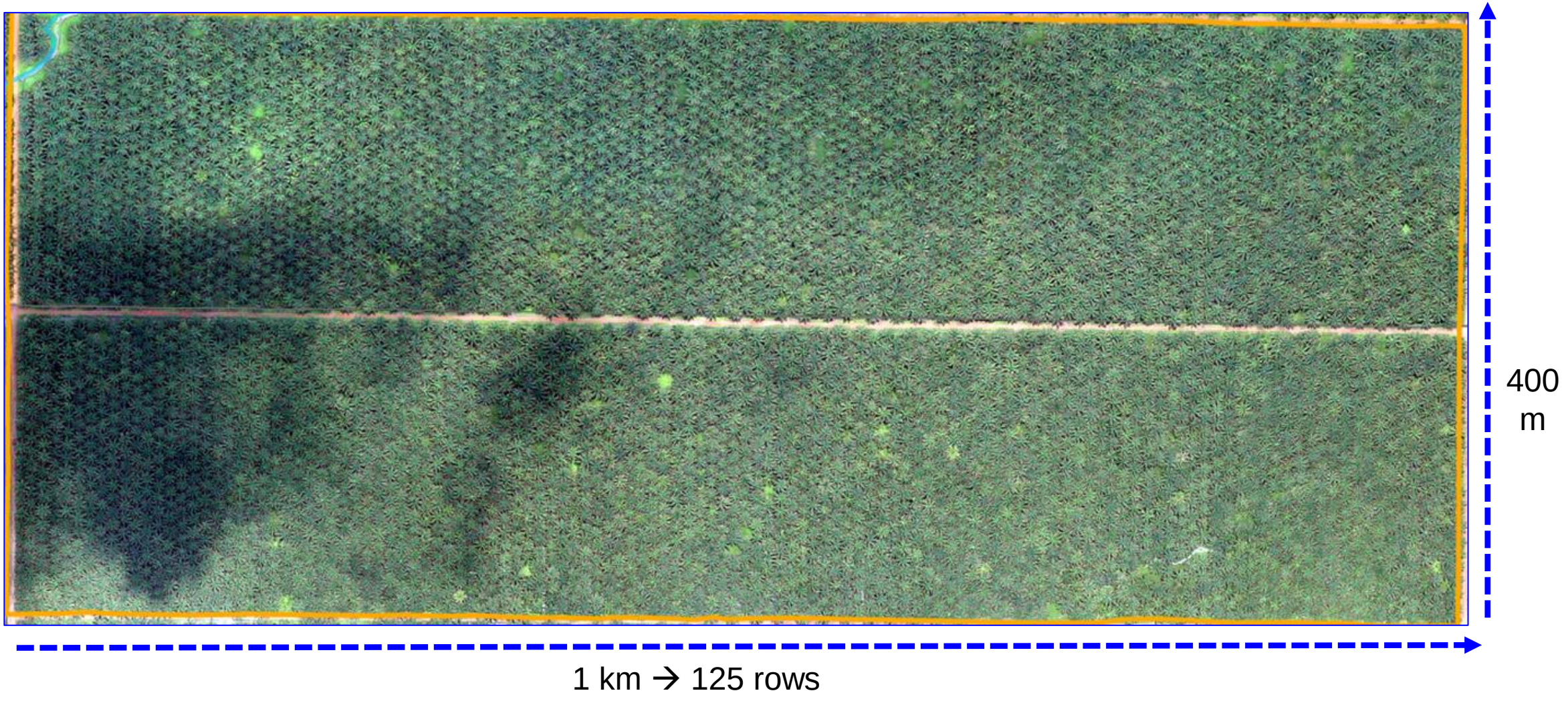
Combining Gold Standards and Innovation

www.researchgate.net/publication/339941885_Organic_Matter_determination_Walkley_-Black_method/figures

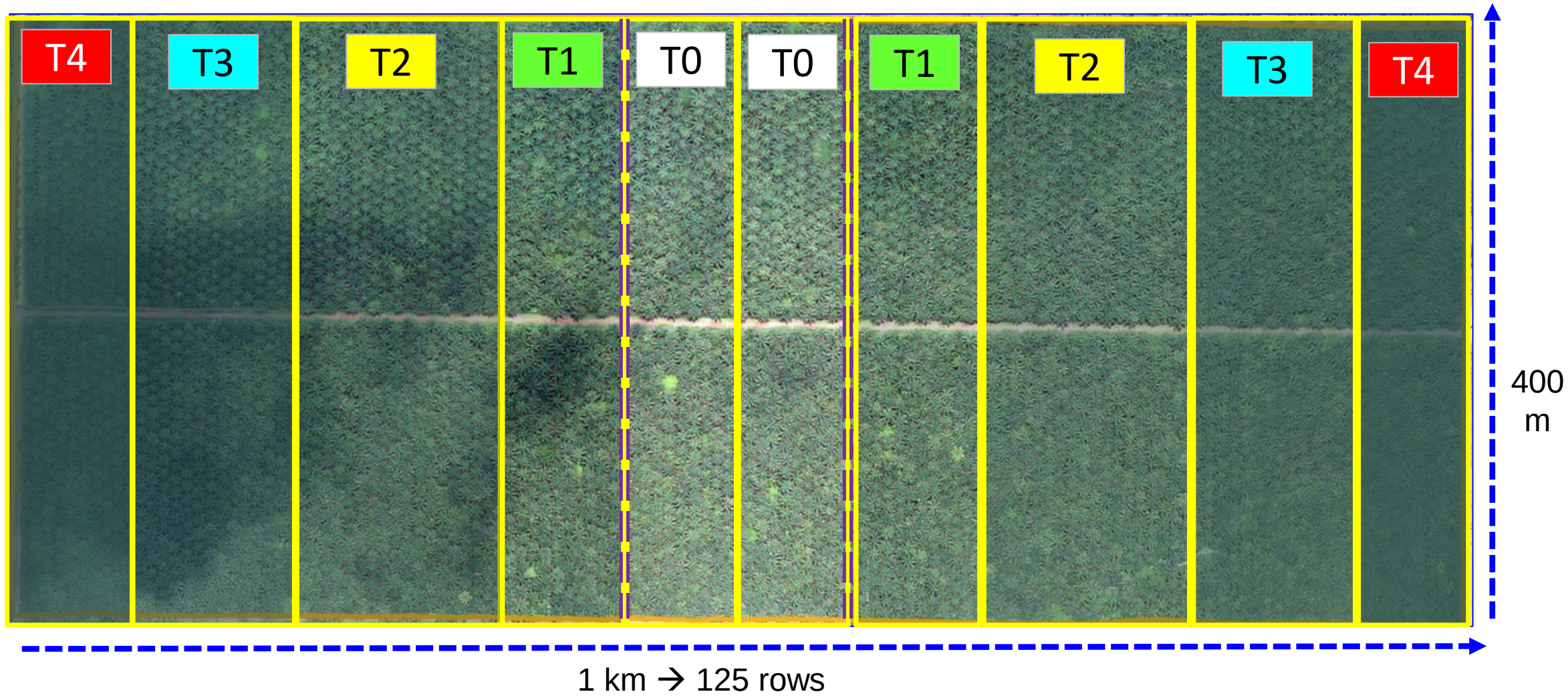


Meng J. *et al.* 2024. Smart mid-infrared metasurface microspectrometer gas sensing system. *Microsyst Nanoeng* **10**, 74.

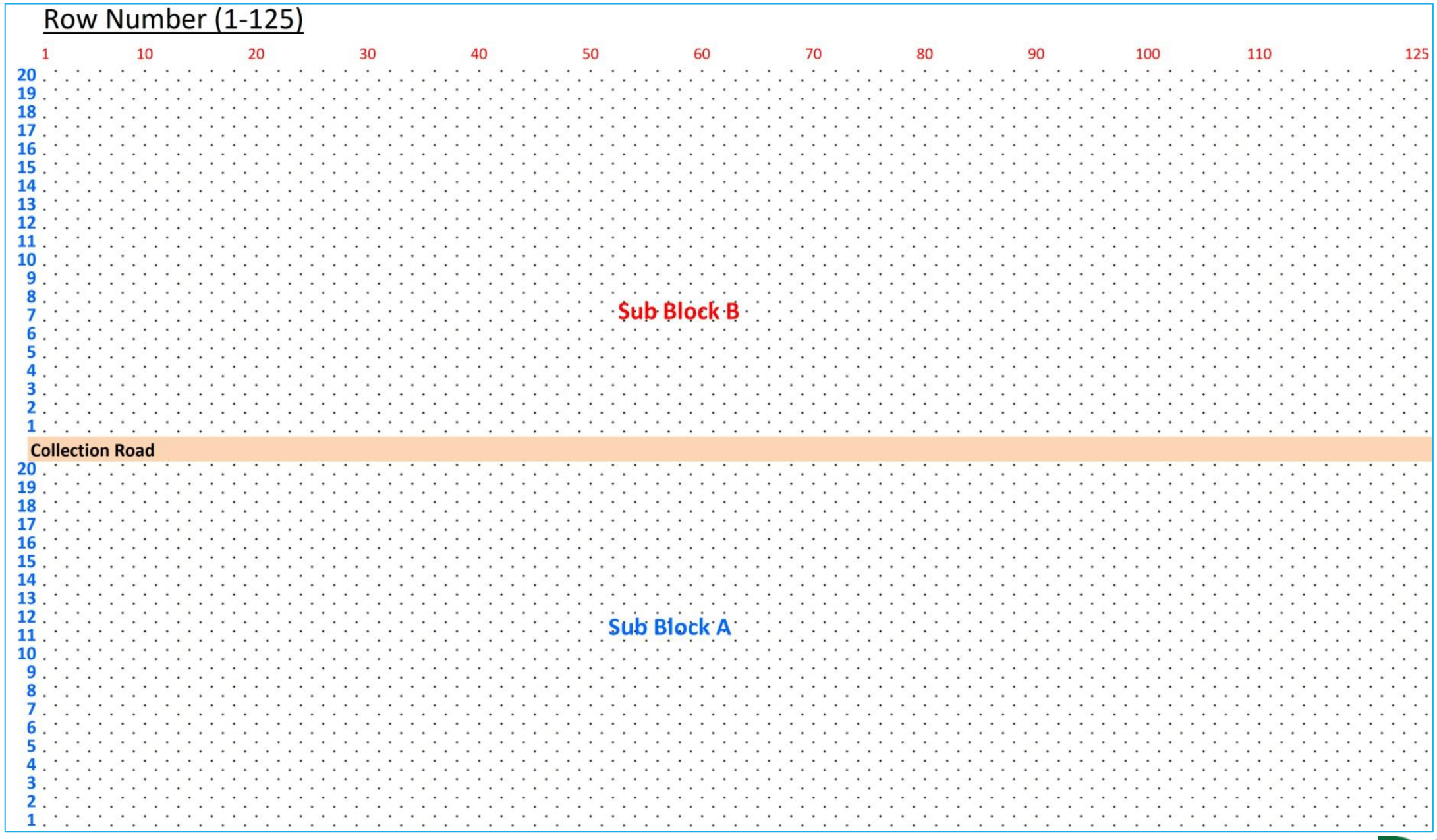
Supportive Sampling Designs



Supportive Sampling Designs



With minimum of unfertilized i.e. 12 rows → < 10%.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125
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19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Sub Block B
Collection Road
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Sub Block A


Row Number (1-125)
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30
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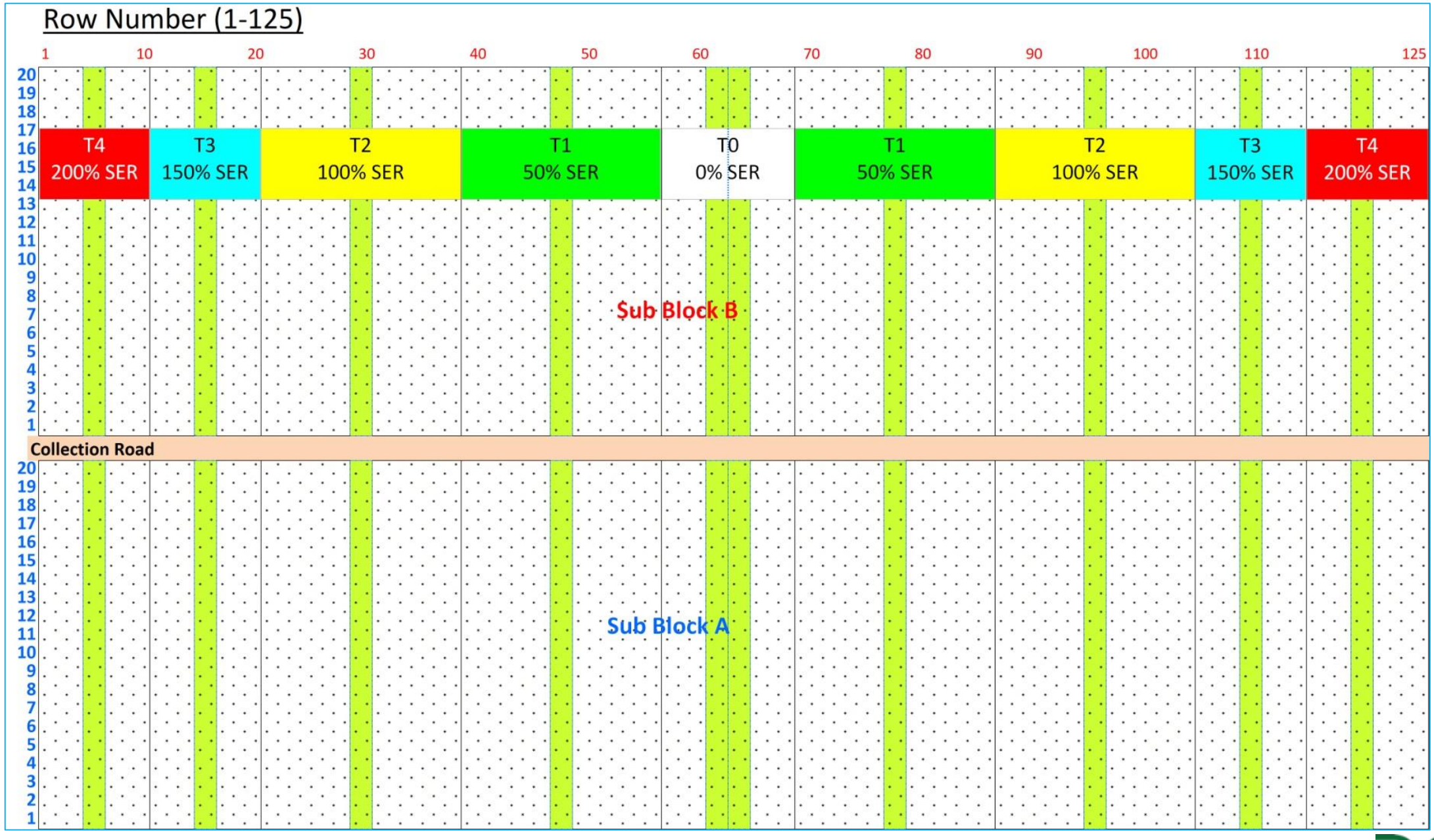
80
90
100
110
125
T4
200% SER
T3
150% SER
T2
100% SER
T1
50% SER
T0
0% SER
T1
50% SER
T2
100% SER
T3
150% SER
T4
200% SER
Sub Block B
Collection Road
Sub Block A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50% SER
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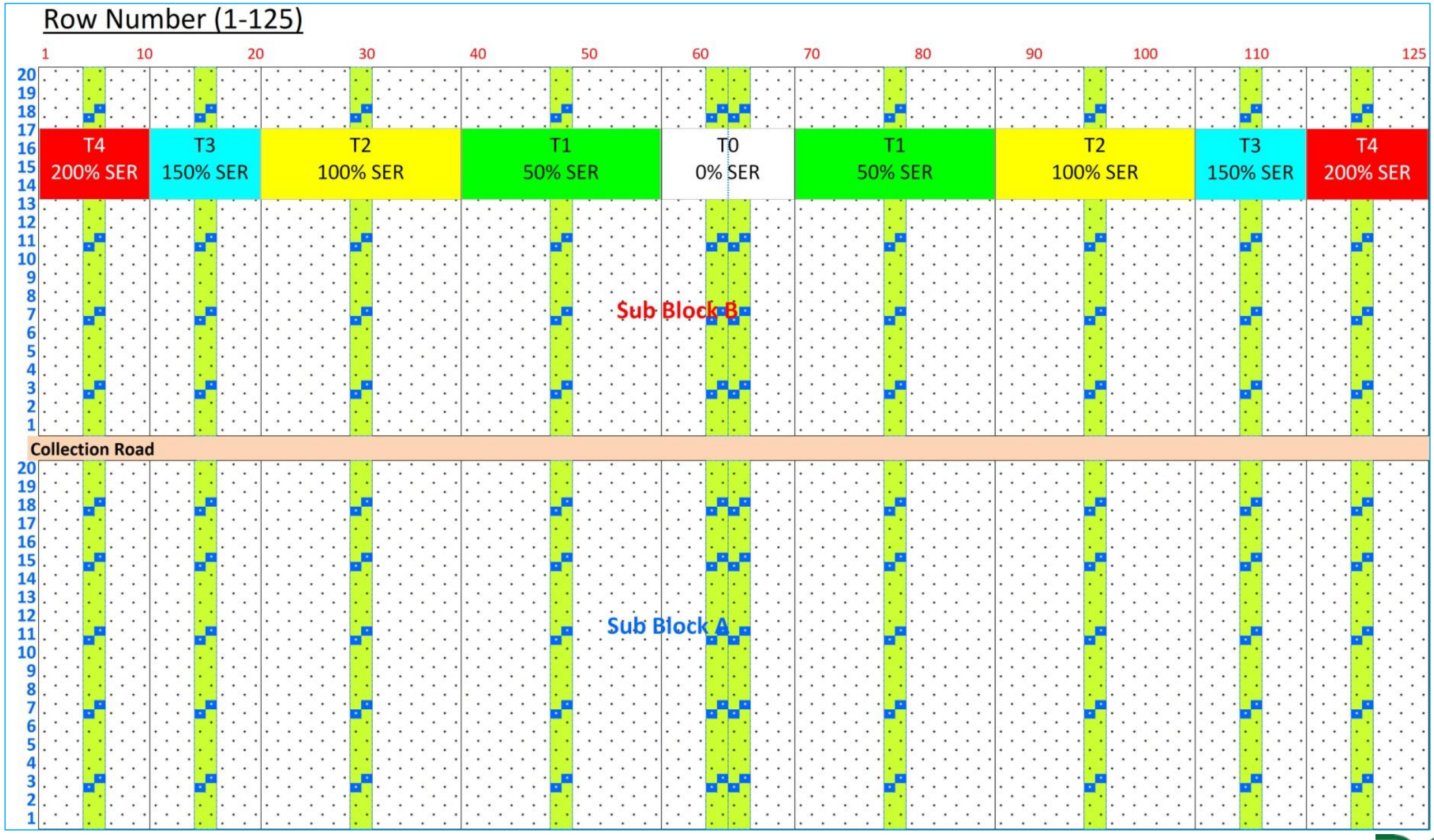
100% SER
T3
150% SER
T4
200% SER
Sub Block B
Collection Road
Sub Block A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0% SER
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50% SER
T2
100% SER
T3
150% SER
T4
200% SER
Sub Block B
Collection Road
Sub Block A

Monitoring of Biomass and Carbon in SAREP

Outcome are scientifically **credible** and market **relevant** processes and data

- Calibrate Above Ground B&C
- Develop Protocols for B&C
- Measure Below Ground B&C
- Optimize pool component interactions
- Insights on fractions, roots, microbiome

Thank you!








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