High Throughput Phenotyping Methods on Peanuts Fields

Alain Audebert, A. Diop, M. Sakho, M. Mbaye, B. Sine, I. Faye,

M. Balota, D. Hoisington and J. Rhoads
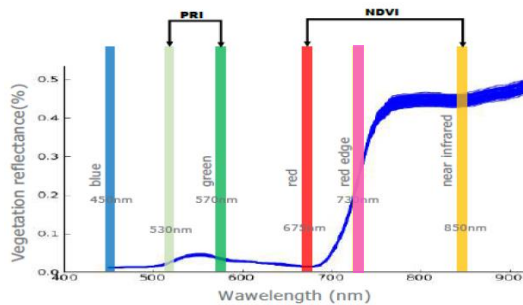
APRES Meeting 16/07/2021

Objectives

- Feasibility of high-throughput phenotyping using UAV-based imaging and GreenSeeker

- Validation of vegetation indices obtained by UAV onboard images

- Methods comparison

Ceraas HTP plateform

- UAV Hexacoptere (Mikrocopter)
  - Multispectral Camera (Airphen)
    - 6 spectral bandes
   - 450; 530; 570; 675; 730; 850 nm

- Handling NDVImeter
  - GreenSeeker (Trimble Inc)
    - 2 spectral bands 660 and 770 nm
- SunScan (Delta T Device)

Material and Method

- 2 experiments (Nioro and Bambey)
  - Inside the groundnut basin
  - Cropping season 2020

- Randomized complete block design
  - 4 blocks
  - 21 peanut varieties

- Dates of measurements
  - 41 DAS
  - 57 DAS
  - 75 DAS

- UAV Flights at 12 am
  - 12 am
  - 25 m above canopy

- Ground measurement at 1 - 3 pm
  - 1-3 pm
  - 0,6 m above canopy
  - 3 rep / plot

24 - 48" (60 - 120 cm)
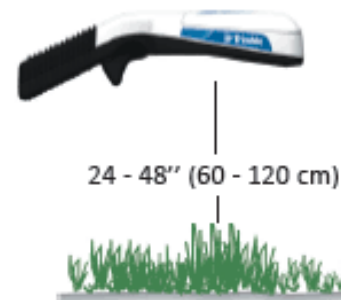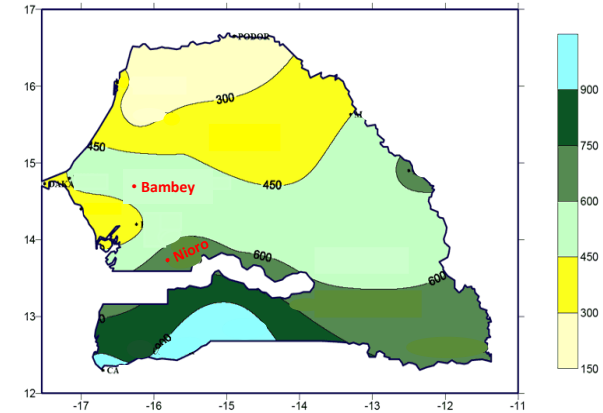
Image treatment pipeline

1. Flight plan definition (Altitude 25 m)

2. Image capture (300 images ; 3-4 Go / flight)

3. Orthomosaïc generation and georeferencing

4. 3D Image (Photogrammetry)

5. Plot delimitation (Shapefile)

6. Data extraction (Vegetation indices)

7. Traits of interest (Calibration need)
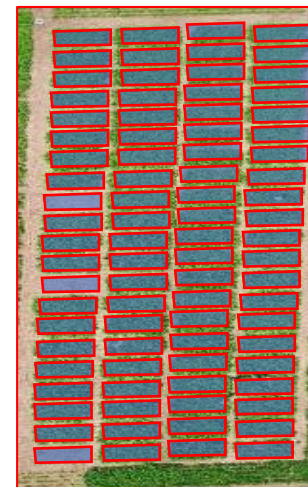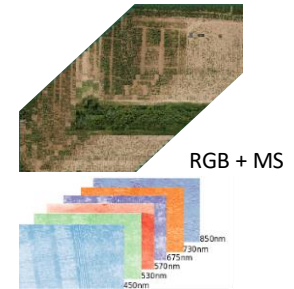
ID	bloc	Plot	Gen	NGRDI	VARI	NDVI	G
1	1	1	1	0.210	0.244	0.223	
2	1	2	30	0.119	0.143	0.128	
3	1	3	37	0.135	0.165	0.144	
4	1	4	13	0.133	0.162	0.133	
5	1	5	28	0.139	0.164	0.146	
6	1	6	27	0.098	0.115	0.115	
7	1	7	26	0.018	0.022	0.022	
8	1	8	11	0.196	0.224	0.208	
9	1	9	9	0.159	0.194	0.170	
10	1	10	12	0.173	0.208	0.180	

Results: ANOVA

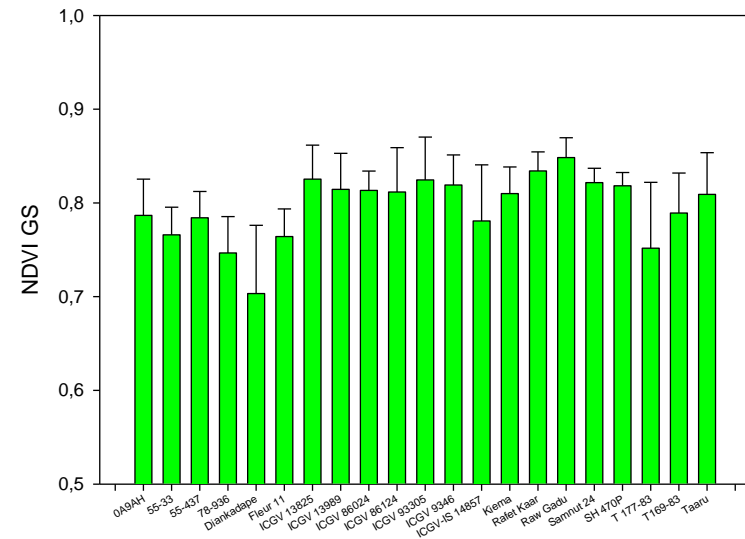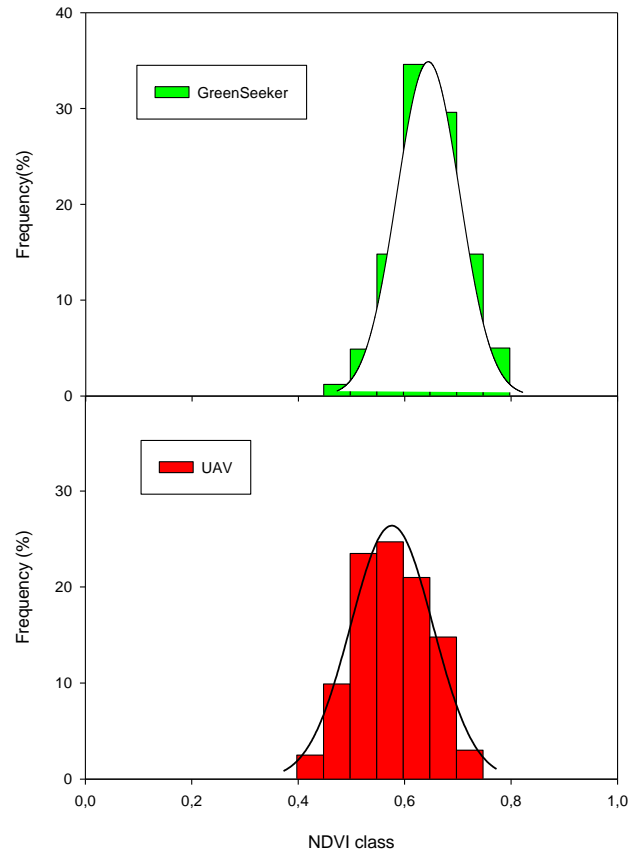|	NDVI UAV	NDVI GreenSeeker	LAI
Site	**	ns	**
Date	***	**	***
Bloc	*	ns	ns
Varieties	***	***	***
Interactions	ns	ns	ns
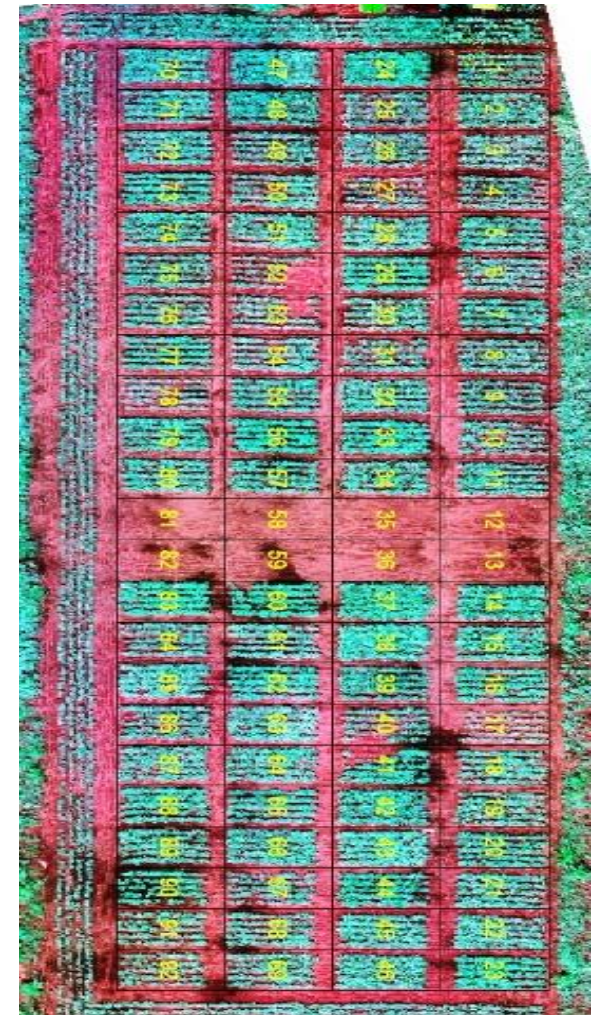
Results : Green Seeker vs UAV
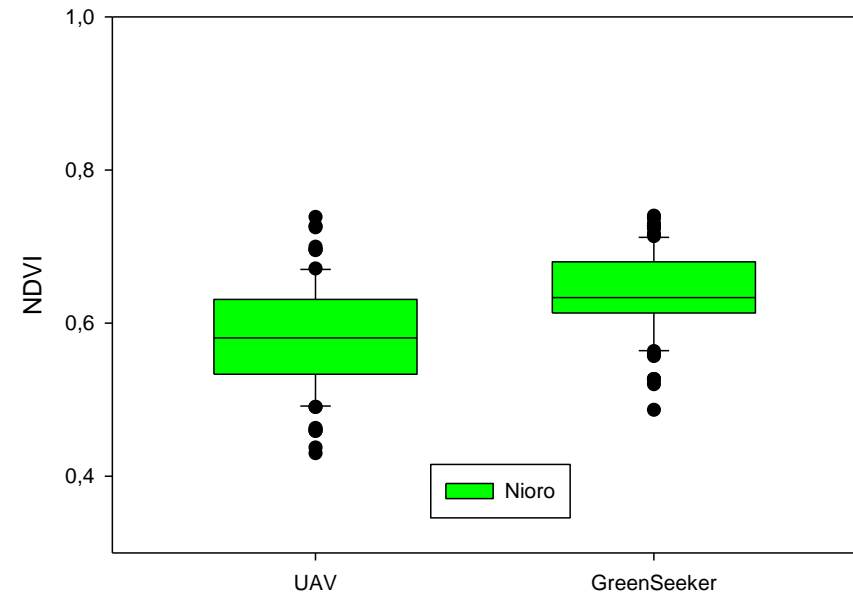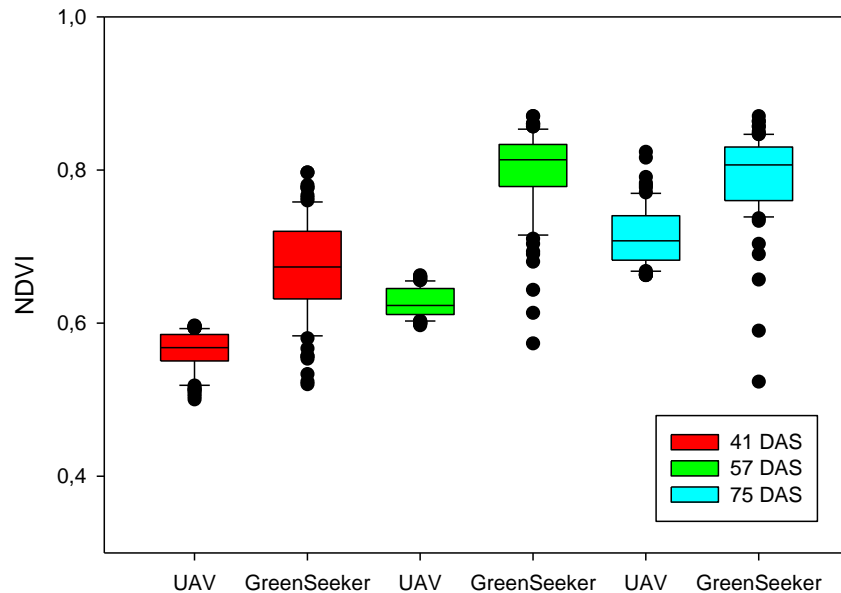
- NDVI from UAV always < Green-Seeker
  - Differences could be explain by
    - High intra plot heterogeneity
    - Green-seeker operator use
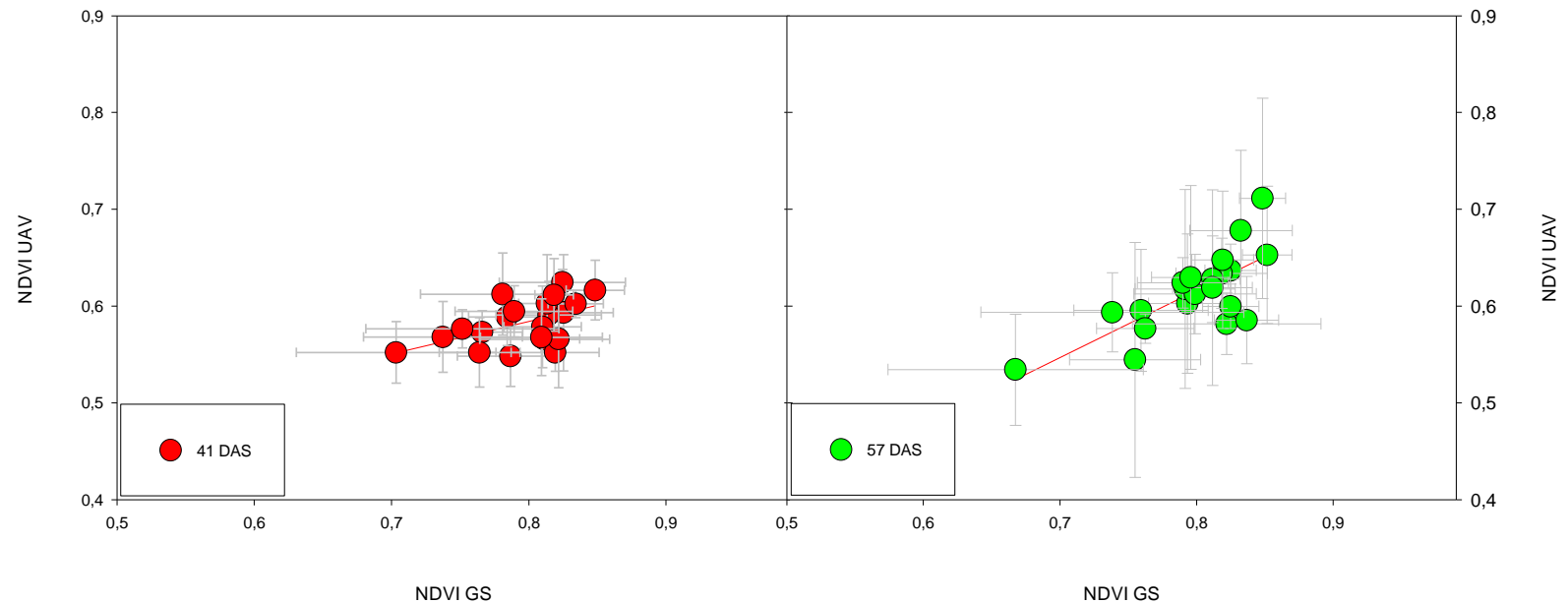- NDVI (UAV and GS) follow the plant growth evolution

Results: Varietal diversity

- The two methods present similar diversity
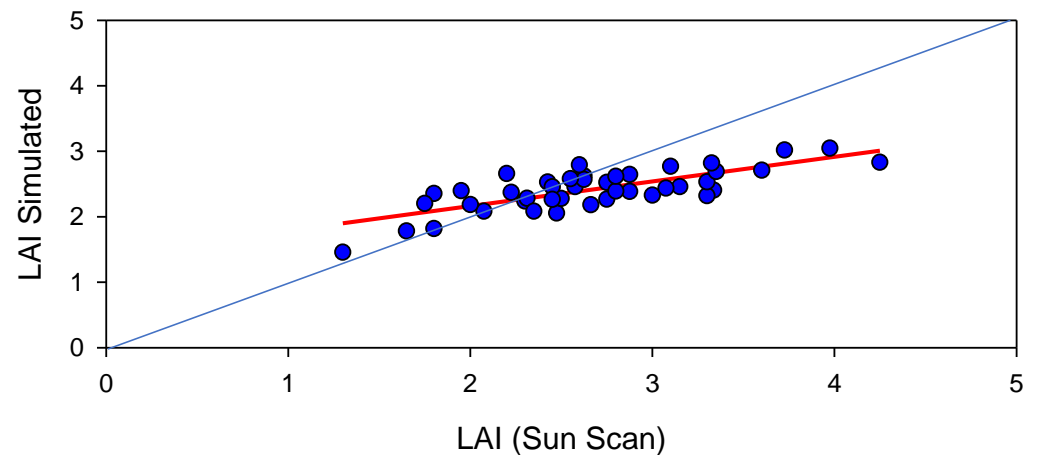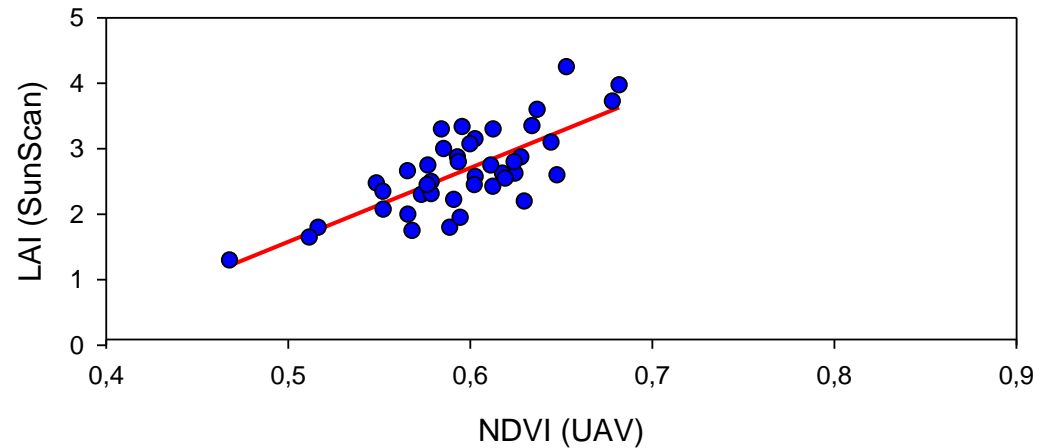- Sufficient for breeding programs

Results

- Not a global relation across date
- But correlation by date / plant stage
- Confirm result from Adeel Hassan et al. 2019

LAI simulation

- Calibration using Bambey trial

- Validation with Nioro data

- Calibration is not well adapted for different environment

- -> need more environment sites for improving calibration

Tools comparaison

	GreenSeeker	UAV (MS camera)
Time in field	2h	10 min
Data treatment	1h	2h
Plot representativity	☺	☺
LAI proxy	😐	😐

Conclusion

- The two methods could be use for Hight Throughput Phenotyping

- Need more data for calibration across experimental site

- Improve GreenSeeker measurement protocol to integrate the intra-plot diversity

Aknowlegment

Moussa Sakho
Assane Diop

Maria Balota

Dave Hoisington
James Rhoads

Bassirou Sine (CERAAS)
Modou Mbaye (CERAAS)
Issa Faye (CNRA)

Alain Audebert