syngenta

Development of a smartphone/tablet app for cereal stand counts

Dr Frank Meier-Runge, Syngenta

EPPO Workshop on Adoption of Digital Technology for Data Generation for the efficacy evaluation of Plant Protection Products Ede, The Netherlands, 2022-06-27/29

Remote/proximate sensing - The Basics

Different devices are used to measure different crop parameters

Smartphone/ tablet

Ground based sensors (Greenseeker, SPAD, or similar device)

Drone with camera/sensors

Robot with camera/sensors

Several sensing parameters can be **measured**

Reflectance of RGB wavelengths

Reflectance of RedEdge

Reflectance of NearInfrared

Reflectance of multi-/hyperspectal bands (e.g. 400 - 1000 nm in 20 nm steps)

Thermal

From the measured parameters more than 100 vegetation indices can be **calculated**

NDVI (Normalized Difference Vegetation Index)

Algorithms

NDRE (Normalized Difference Red Edge)

EVI (Enhanced Vegetation Index)

RVI (Ratio vegetation index)

SAVI (Soil Adjusted Vegetation Index)

GI (Greenness index)

Algorithms (AI)

Images, reflectance and vegetation indices used to **estimate** different Crop/Target parameters

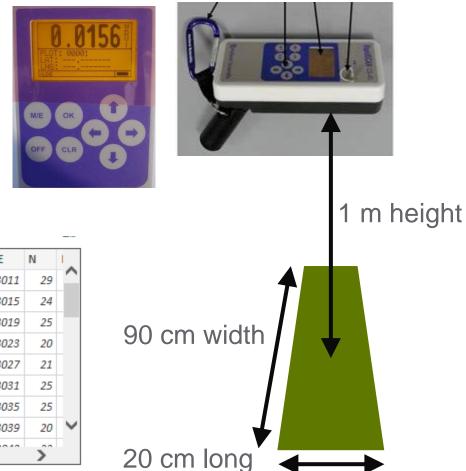
Foliar area
Crop density
Chlorophyll activity
Phytotoxicity
Chlorosis
Stunting
Vigor
Plant height
Plant count
Insect count
Disease incidence
Target severity
Crop nutrients content
Yield



Example: Proximate canopy sensing with RapidSCAN

- Own light source (not sunlight dependent)
- Continuous scanning when moving (variable plot sizes)
- Measures %Reflection in Red, Red-Edge and Near-Infrared
- Calculates NDVI and NDRE (including standard deviation & coefficient of variation), more VIs can be done in Excel/ARM
- Additional site data (GPS)
- Records data and transfer to PC (Excel/ARM)

PLOT	NDRE	NDVI	RE	NIR	R	LATITUDE	LONGITUDE	ELEVATION	HDOP	FIXTYPE	DATE	TIME	N	1
1	0.2763	0.774	20.046	35.358	4.503	50.237274	8.5841973	228.9	2.54	GPS	280122	123011	29	
2	0.2834	0.7824	19.954	35.741	4.362	50.2372925	8.5841763	217.6	0.91	GPS	280122	123015	24	
3	0.2829	0.784	19.96	35.714	4.325	50.2372861	8.5841656	220.2	0.91	GPS	280122	123019	25	
4	0.2873	0.7857	19.904	35.952	4.313	50.2372838	8.5841626	221.3	0.91	GPS	280122	123023	20	
5	0.2829	0.7827	19.961	35.709	4.353	50.2372835	8.5841601	221.7	0.91	GPS	280122	123027	21	
6	0.2824	0.7841	19.967	35.682	4.318	50.2372835	8.5841575	221.9	0.91	GPS	280122	123031	25	
7	0.2826	0.7823	19.965	35.693	4.36	50.2372826	8.5841573	222.1	0.91	GPS	280122	123035	25	
8	0.2848	0.7846	19.936	35.818	4.324	50.2372785	8.584161	223.1	0.91	GPS	280122	123039	20	
(0.0000	0.7044	40.000	25.050	* 000	50 0070705	0.5044.504	22.4	0.04	000	200422	400040	>^^	





Other digital tools used in Syngenta EAME

- **GreenSeeker**: handheld crop sensor used as measurement device for NDVI from the biomass and will present an average of the health or vigor of the crop
- **SPAD:** Soil Plant Analysis Development Device
- **Stenton FarmLab**: On-Field soil analysis
- In evaluation: App for greenness measurement, assessments using drones as platform











Background

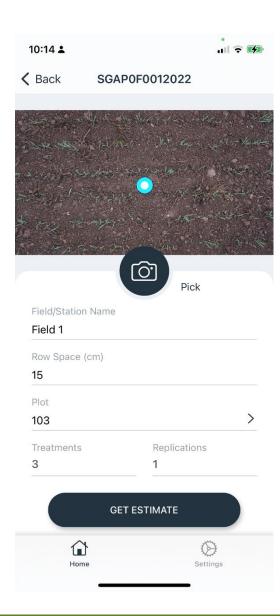
- Stand count or count of emerged plants is a common assessment done in seed care trials in cereals and other crops, however it is time consuming.
 - ➤ On average, it can take up to 90 minutes to do a stand count assessment

<u>Goal</u>

- An application that counts the number of emerged cereal plants (50% emergence & 1-2 leaf stage) without reduction in accuracy
 - Simple & monotonous assessment = can now be done within seconds

KPI

<10% Deviation from manual assessment

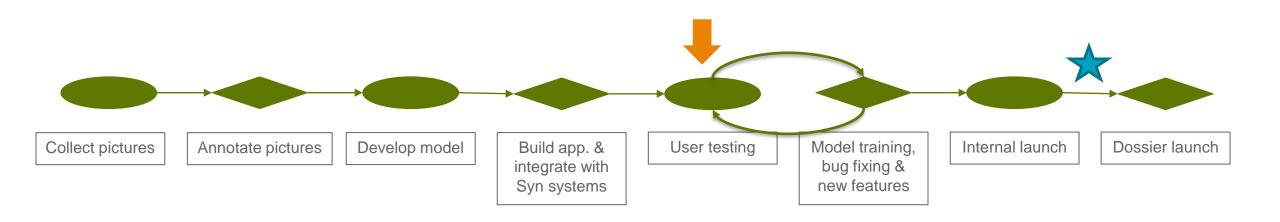






Status

- Currently in <u>Pilot phase</u>
 - Refinement of model to take place during user testing











Model

- Blended model based on machine learning from a training dataset and synthetic images (predicted plant locations)
- The training dataset is comprised of annotated pictures taken under similar conditions expected in the field
 - The dataset is further enriched by applying data augmentation techniques typical for object recognition models (e.g., image rotation, image flipping etc.)

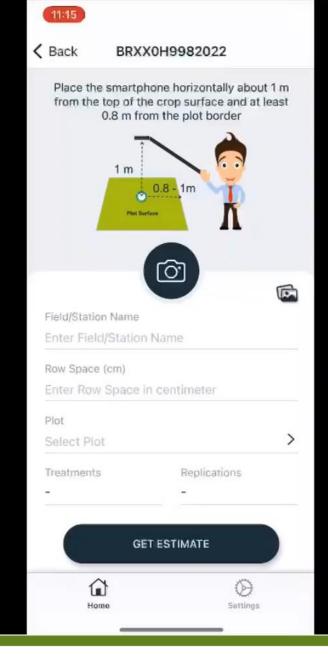






Results

- The output includes:
 - Count, Area, Plants per m2 and Count per row meter
- "row meter measured" per plot to be added
- Video speed 67%









Results

Data comparison from test dataset

