PHENOSPEX
Smart Plant Analysis

MICROSCAN
Portable 3D & Multispectral Phenotyping

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TECHNICAL SETUP

Fig. 1: Assembled MicroScan. The PlantEye F500 sensor allows for 3D and Multispectral imaging.

MicroScan enables you to digitally measure plants on all of your locations. Measure plants noninvasive and analyze them for tasks like growth reports, chemical screenings or disease quantification.

- X Sensor works in sunlight
- X High resolution
- X Objective crop assessment
- X Light weight system, just below 28 kg
- X Automated data analysis

Travel to your plants and start phenotyping. The MicroScan is assembled and ready to use in 5 minutes. With the protective case we make sure that traveling is safe and easy.

Fig.2: The MicroScan protective case weighs 28 kg including all components allowing you to travel anywhere.

Easily automate phenotyping applications like:

- X Bioassays
- X Chemical screenings
- X Quality control
- X Germination assay

Get a demo at the Phenospex booth

Come and see our live demo of the MicroScan. We are happy to provide you with more information about our products and discuss how they can fit your needs.

PLANT & DATA ANALYSIS

1. 3D & MULTISPECTRAL SCAN

MicroScan moves a PlantEye F500 sensor over your plants and creates a 3D model with spectral information (fig. 3, 5).

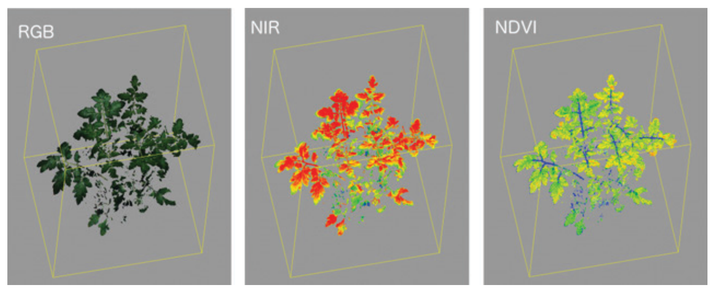

Fig.3: 3D models of tomato plant show RGB, NIR and NDVI values

2. PLANT PARAMETER CALCULATIONS

The 3D models are used to calculate morphological and multispectral plant parameters. The data is then sent to HortControl to visualize and analyze the plant traits.

Morphological

- X Plant height
- X Plant growth
- X 3D leaf area
- X Projected leaf area
- X Digital biomass
- X Leaf inclination
- X Leaf area index
- X Light penetration depth
- X Leaf coverage

Spectral / Color

- X Hue values
- X NIR
- X Greenness
- X NDVI
- X NPCI
- X PSRI
- X More in development

With these parameters you can for example:

- X Measure Chlorophyll levels, they strongly correlate with NPCI
- X Quantify Diseases with NDVI (fig. 5, 6, 7)
- X Detect Senescence with NDVI

3. DATA ANALYSIS

HortControl is the central software to setup and manage your experiments. Within seconds after the scan all plant data is stored locally on your site. Visualize and analyze plant data with graphs, plots or tools like growth reports and germination assays. (Fig. 4 & 8)

- X Time aggregation
- X Group genotypes and/ or treatments
- X Filter on time, treatment or genotypes

Fig. 4: Line graph showing growth dynamics of tomato plants. Plant height (y-axis) in mm visualized over time in hours (x-axis).

APPLICATIONS

DISEASE QUANTIFICATION

In this example we use NDVI to automate the quantification of *Xanthomonas* on cabbage plants. We scan the cabbage plants (fig 5.) and quantify the amount of diseased tissue.

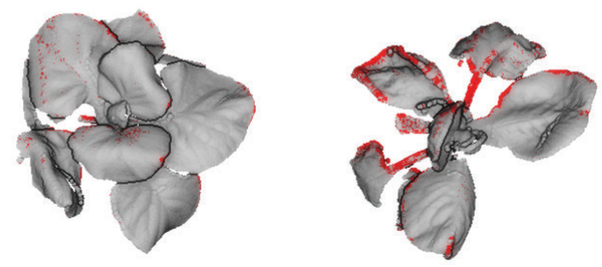

Fig. 5: Red shows precise quantification of diseased leaf tissue on cabbage plants (*Brassica oleracea ssp.*). Treatment plant(right) is inoculated with *Xanthomonas campestris.*

To explain the quantification we visualize the healthy plant (fig. 6) and the infected plant (fig. 7) in a NDVI histogram. This shows exact distribution of biomass on the NDVI scale. The red tissue in the 3D model(fig. 5) has a NDVI value between -0.1 and 0.3. This means unhealthy or diseased leaf tissue.

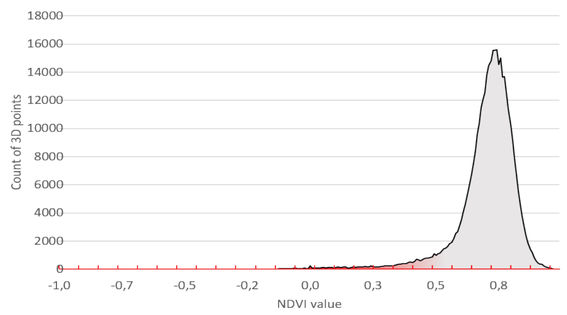

Fig. 6: Healthy plant(fig. 5 left) NDVI signature. Distribution of plant biomass peaks in the healthy 0.8 NDVI value.

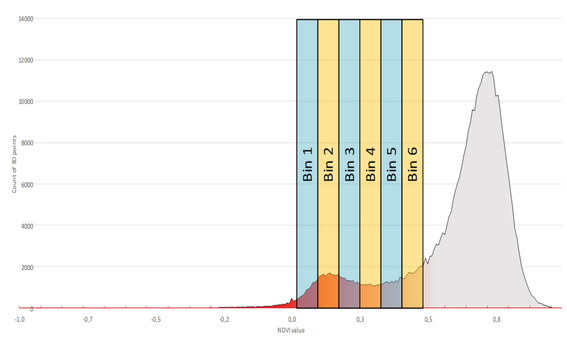

Fig. 7: Unhealthy plant(fig. 5 right) NDVI signature with binning range example. Unhealthy plant shows a second peak in the unhealthy range of -0.1 and 0,3 on the NDVI scale.

The histogram of the unhealthy plant we overlaid with “Bins”. These contain the exact amount of biomass in this region. The values of these bins are visualized in graphs showing progression of the disease over time.

GROWTH ANALYSIS

In this experiment we measured changed lighting conditions on lettuce plants. We measured the effects on growth with the height parameter and the anthocyanin content with the color parameter.

We made 5040 measurements by scanning the plants every 2 minutes for 7 days. Due to the high scan interval we can see a fast plant response to the change in lighting (Fig. 8). The treatment group grows significantly slower. Changes in the red coloring shows the treatment group produces more anthocyanin.

Visit our booth and get more detailed information about this experiment.

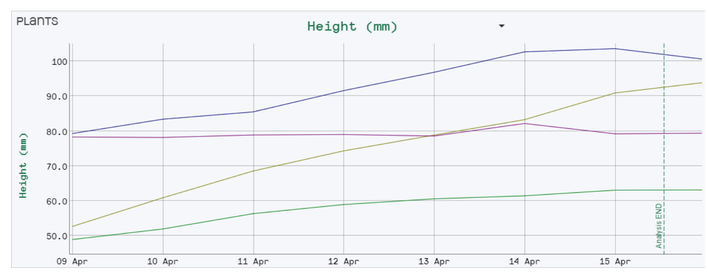

Fig. 8: Line graph showing growth dynamics of 4 groups of lettuce plants. Plant height (y-axis) in mm visualized over time in hours (x-axis).

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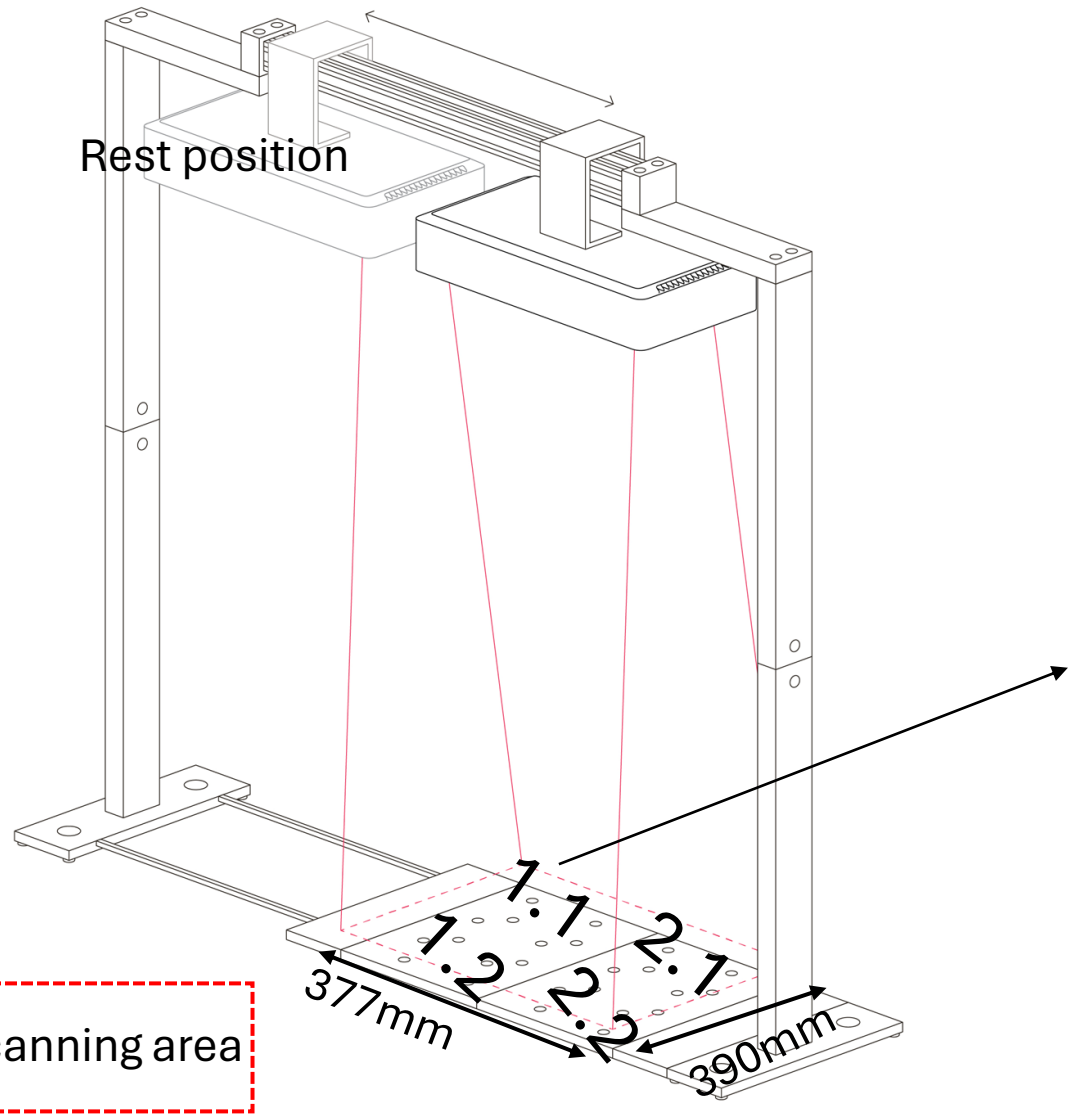
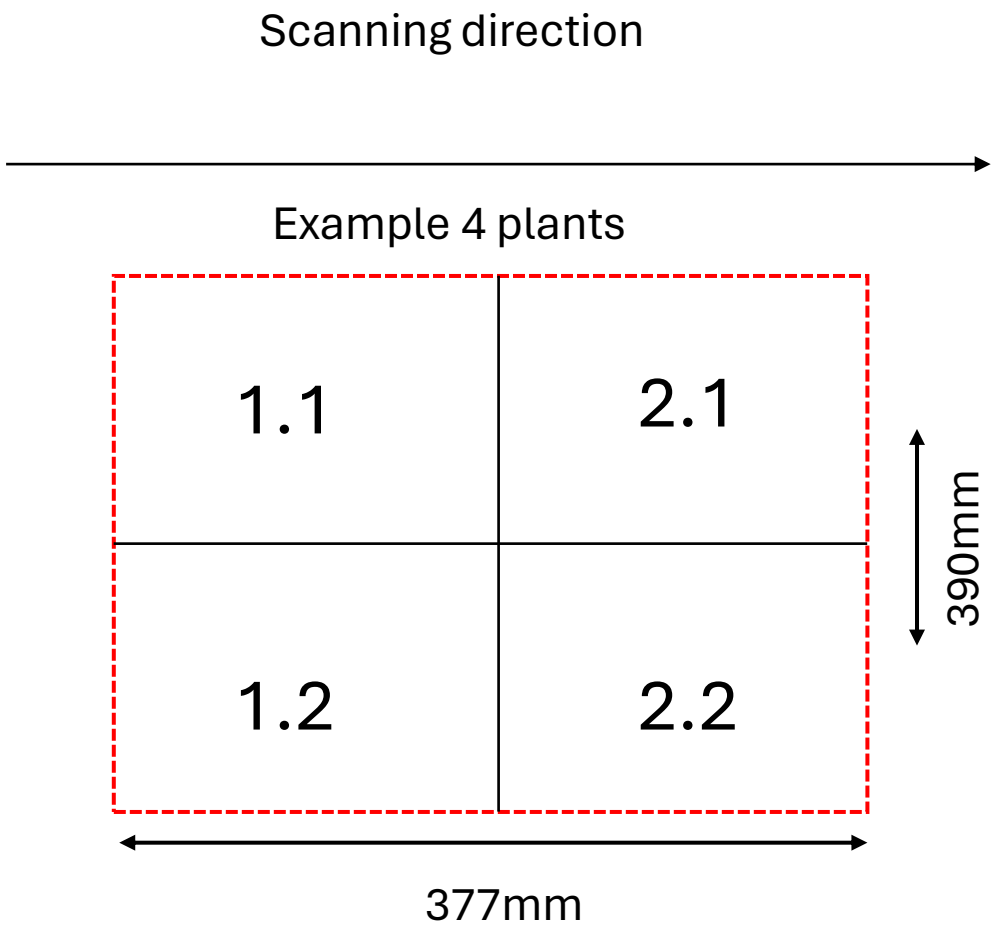
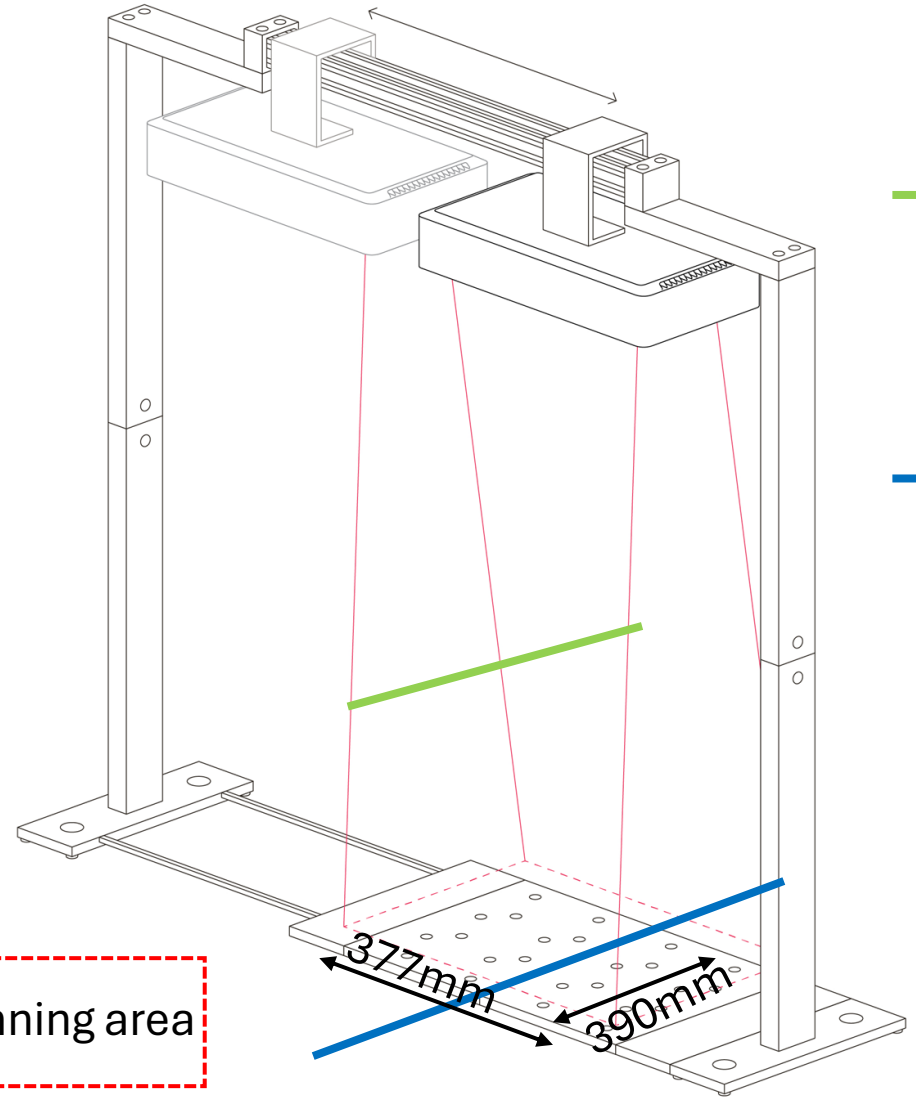
MicroScan overview movement direction

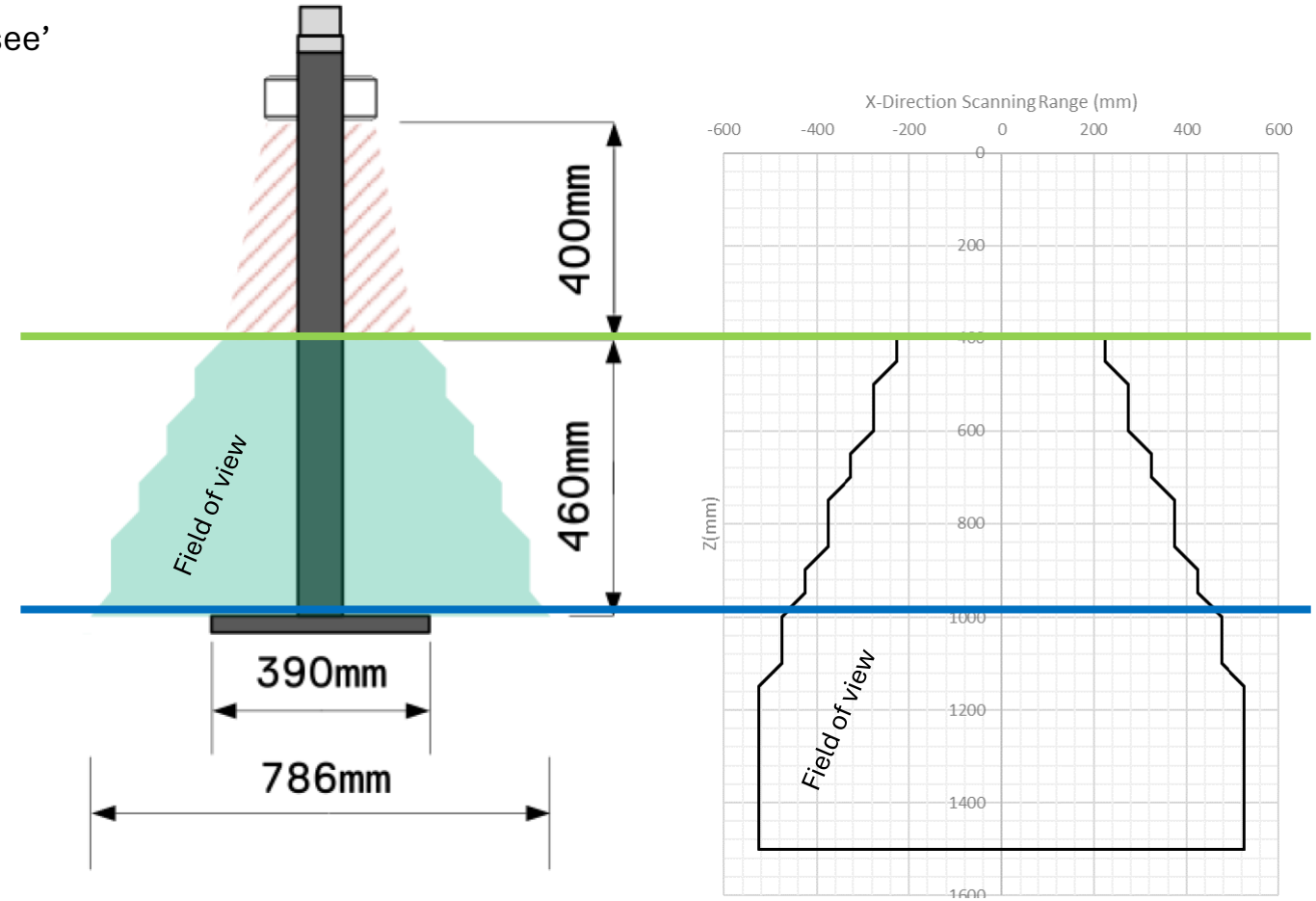




If plants are higher up (green line), scanner can only ‘see’ 390mm wide, if plants are at the bottom of the MicroScan (blue line), scanner can ‘see’ 786mm wide

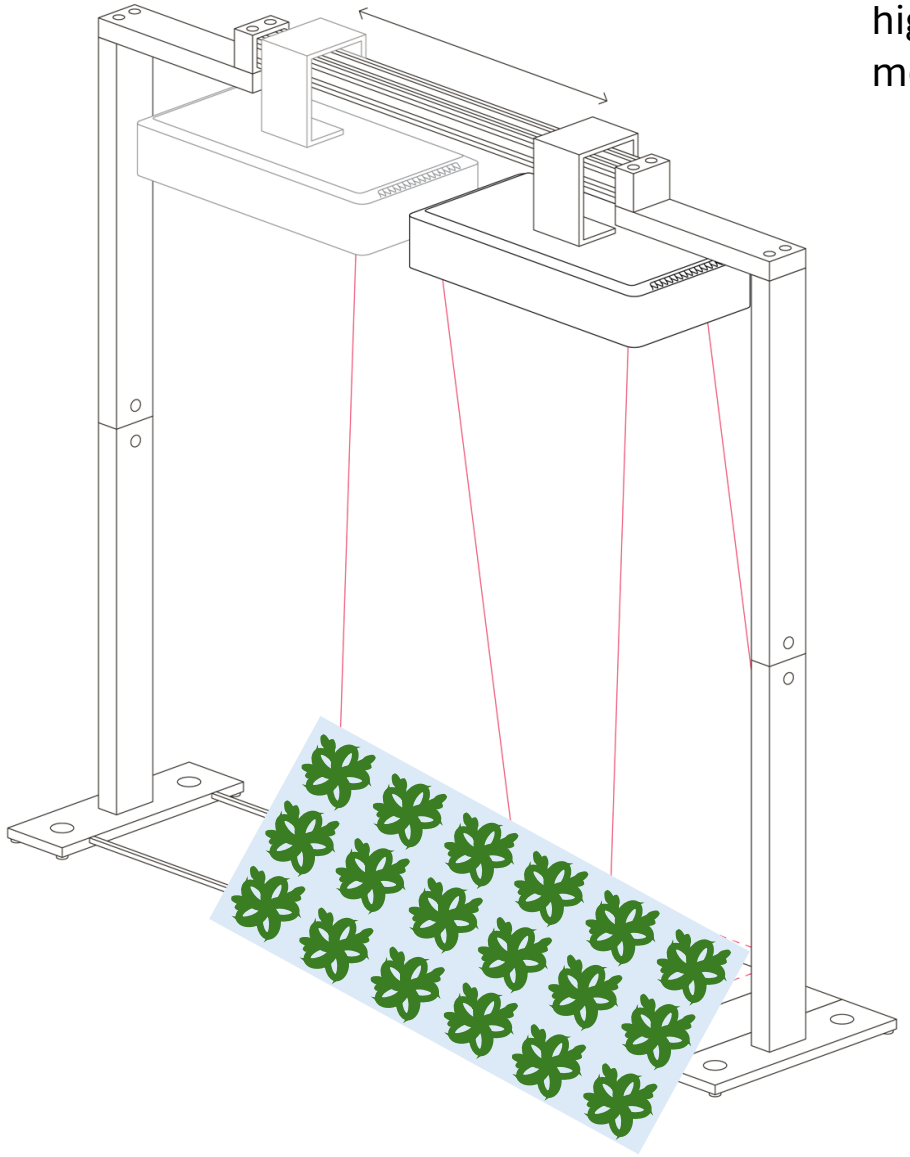


Scanning area



Z Range [mm] (Distance to F600)	X Range [mm]
400	450
450	450
500	550
550	550
600	550
650	650
700	650
750	750
800	750
850	750

Scanning length (377mm) not long enough to scan flat this direction



At a distance of 650 mm from the scanner, scanner can ‘see’ a width of 650 mm, flat needs to be positioned like shown below and as long as the highest plant part has a distance of 650mm from scanner, full flat can be measured.