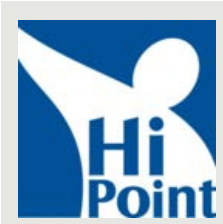




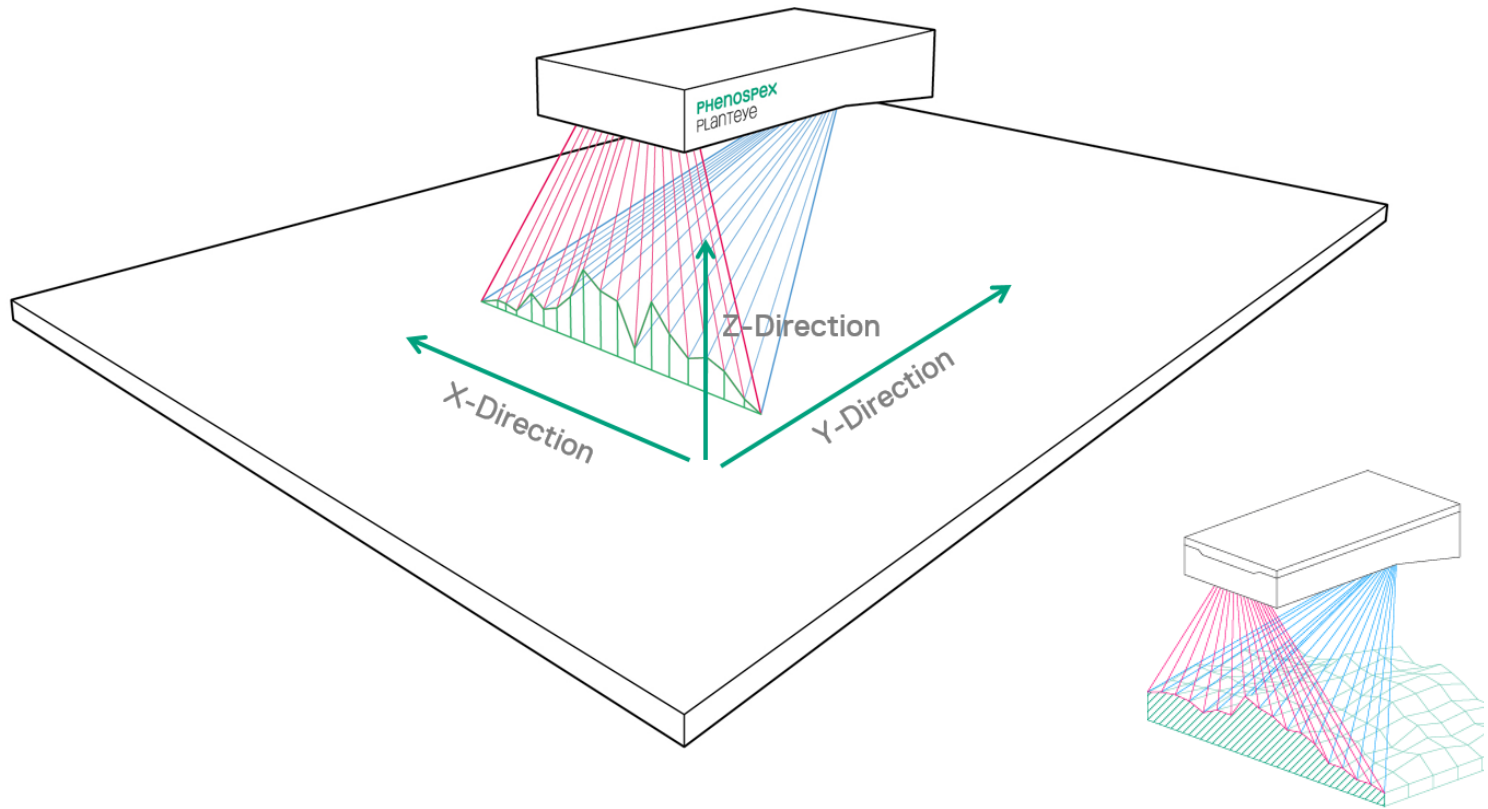
溫室植物表型自動掃描量測系統 功能說明

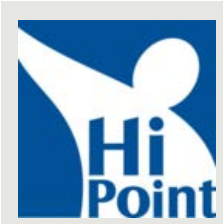


Phenospex系統

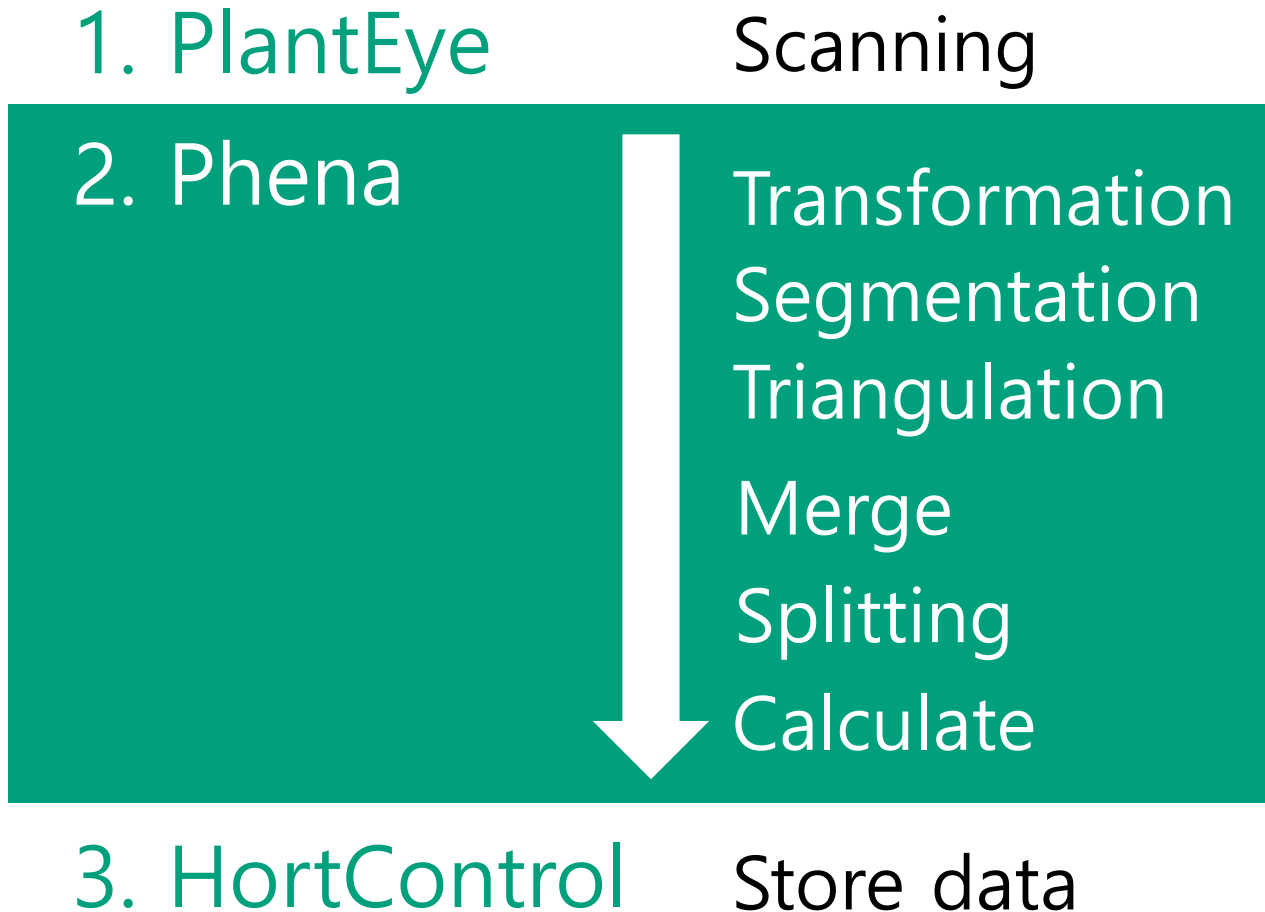


掃描原理





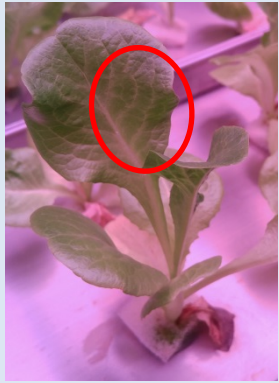
Processing workflow



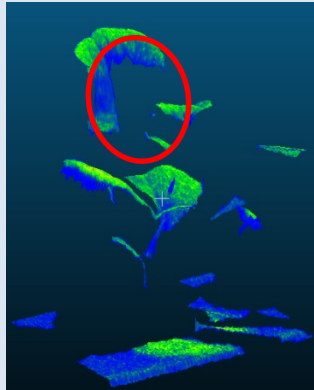
取像範圍及精度



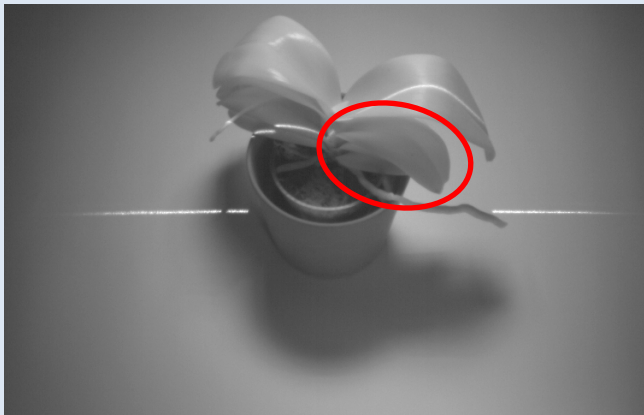
遮蔽問題 1



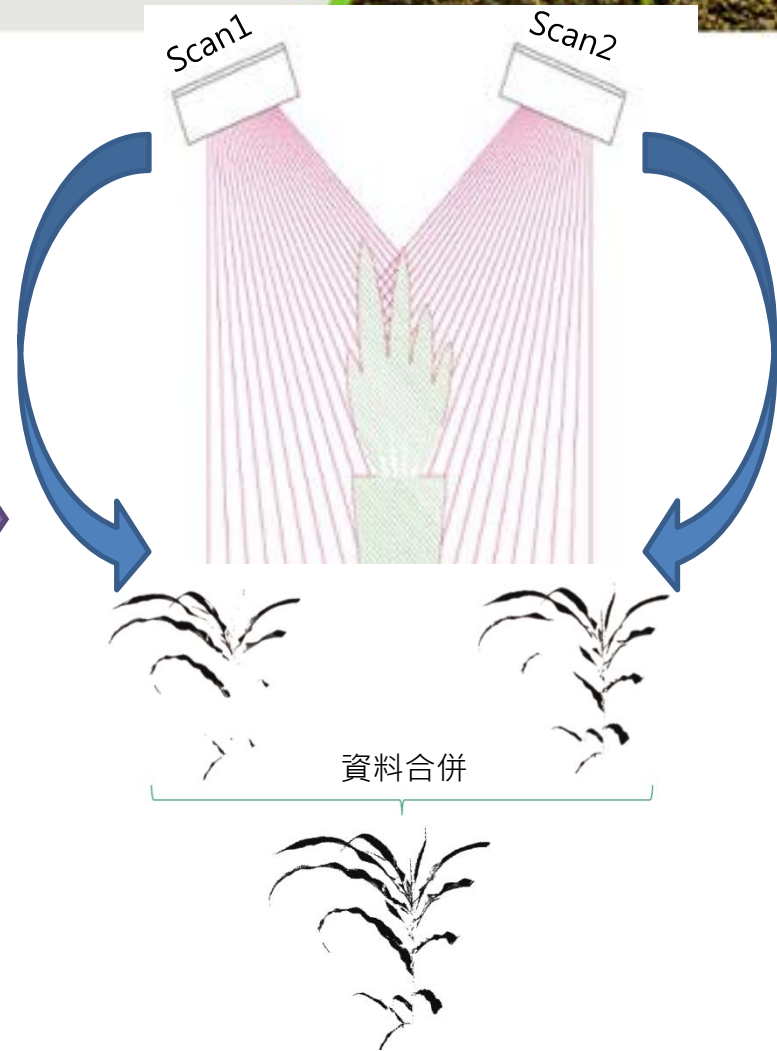
掃描

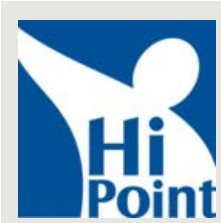


遮蔽問題 2

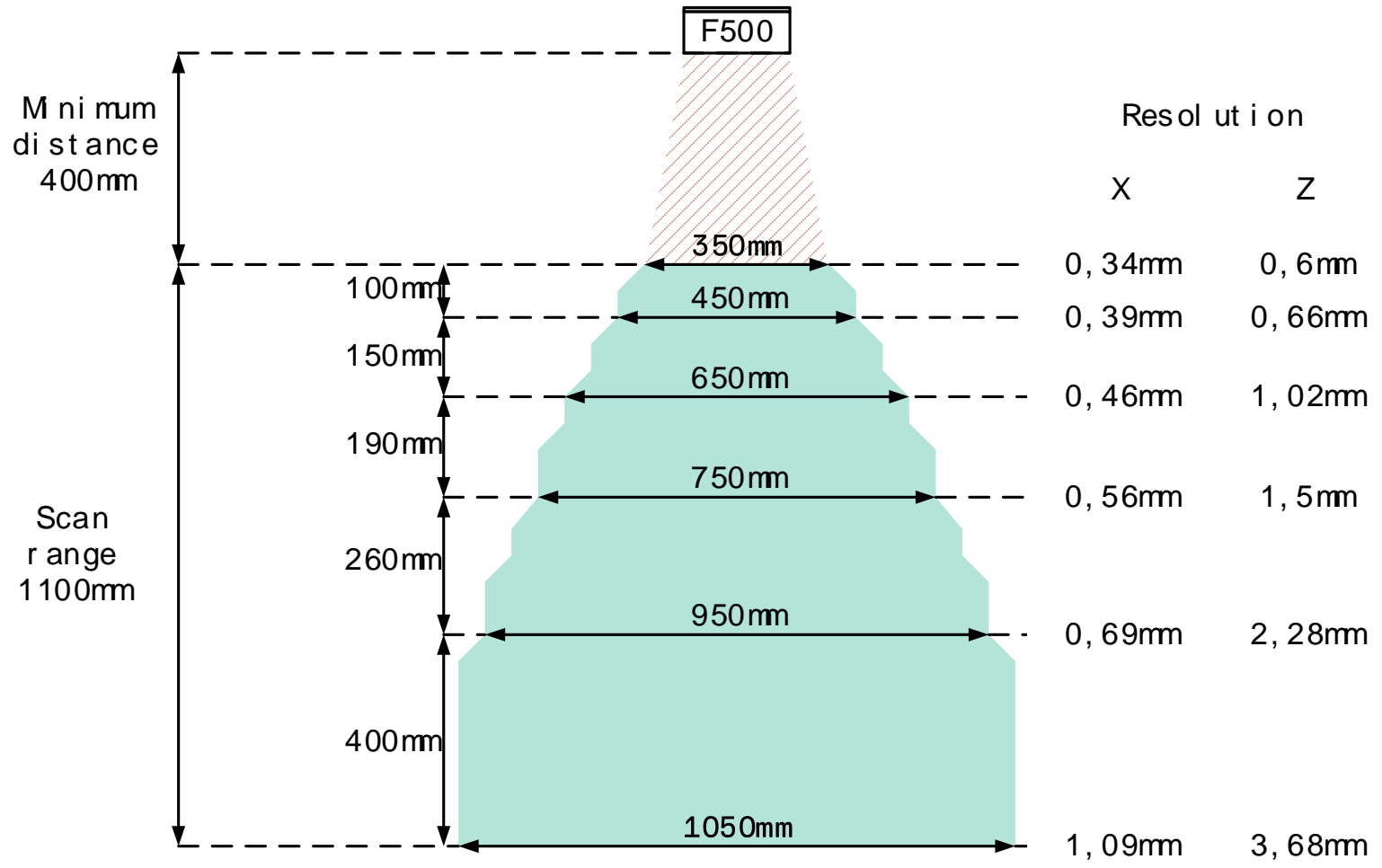


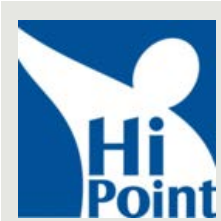
解決
方法





取像範圍及精度





燈號說明



1 – Power Status (green)

Off – PlantEye is powered off

On – PlantEye is powered on

2 – Scan Status (green)

Off – PlantEye is not scanning, enable signal is off

On – PlantEye is scanning, enable signal is on

3 – Link Status (yellow)

Off – not used in current model

4 – Error Code (red)

Off – No error

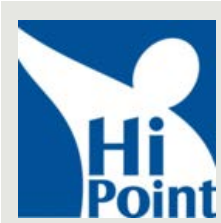
Powered
Scanning
HC connection
ERROR



Complete Sequence	Error Code	Description
- ...	1	Failure of internal temperature sensor
-- ...	2	Fan Failure



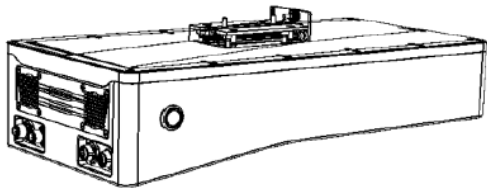
Processing workflow



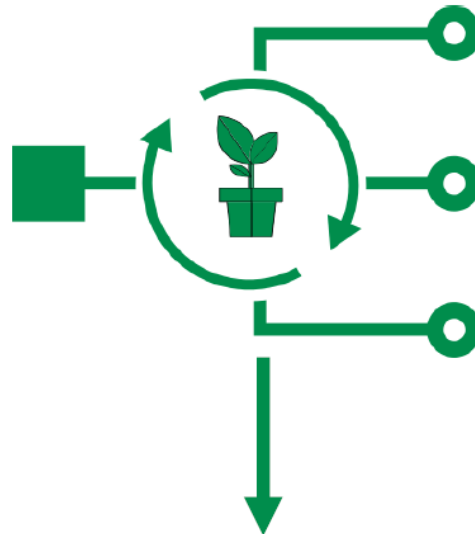
Processing workflow



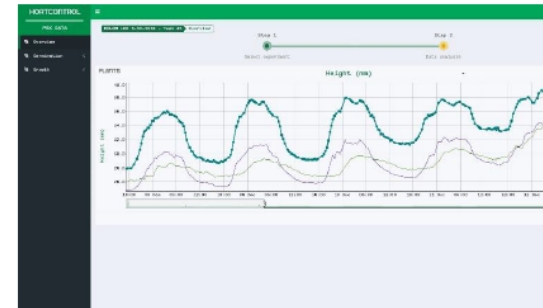
PlantEye

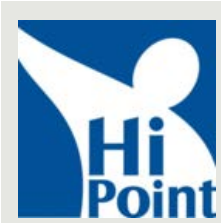


Phena



HortControl





Segment



BLOCKS SELECTED
30
Select/Create a layout for your blocks

Block layout
NL Tomato
Add NL Tomato... **Pot Height**
0
Circular crop radius (mm)
10000
Split configuration
Rectangular

Block layout

Block area

Block width (mm): -200, -100, 0, 100, 200, 300

Block length (mm): 0, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000

Unit

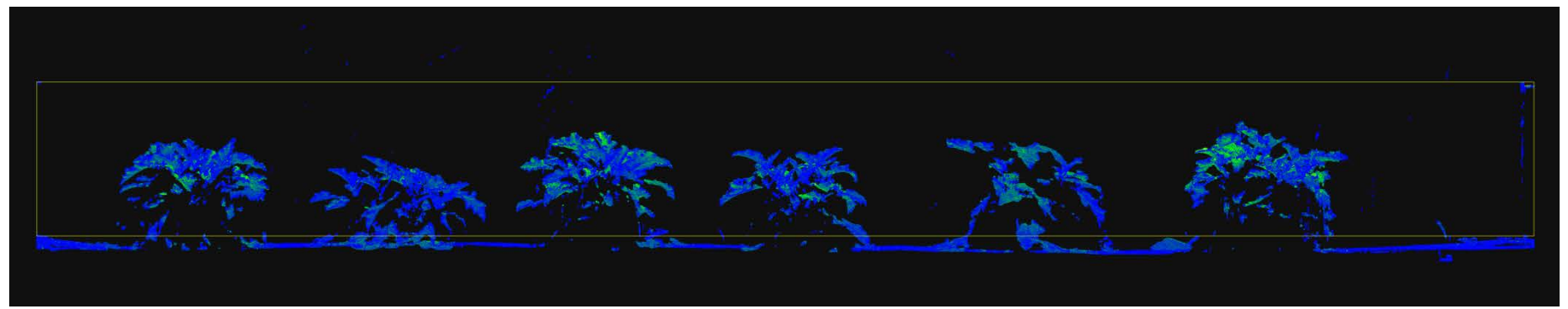
Block dimensions: 750 x 4000

Block splitting: 1 x 10

Unit dimensions: 400 x 400

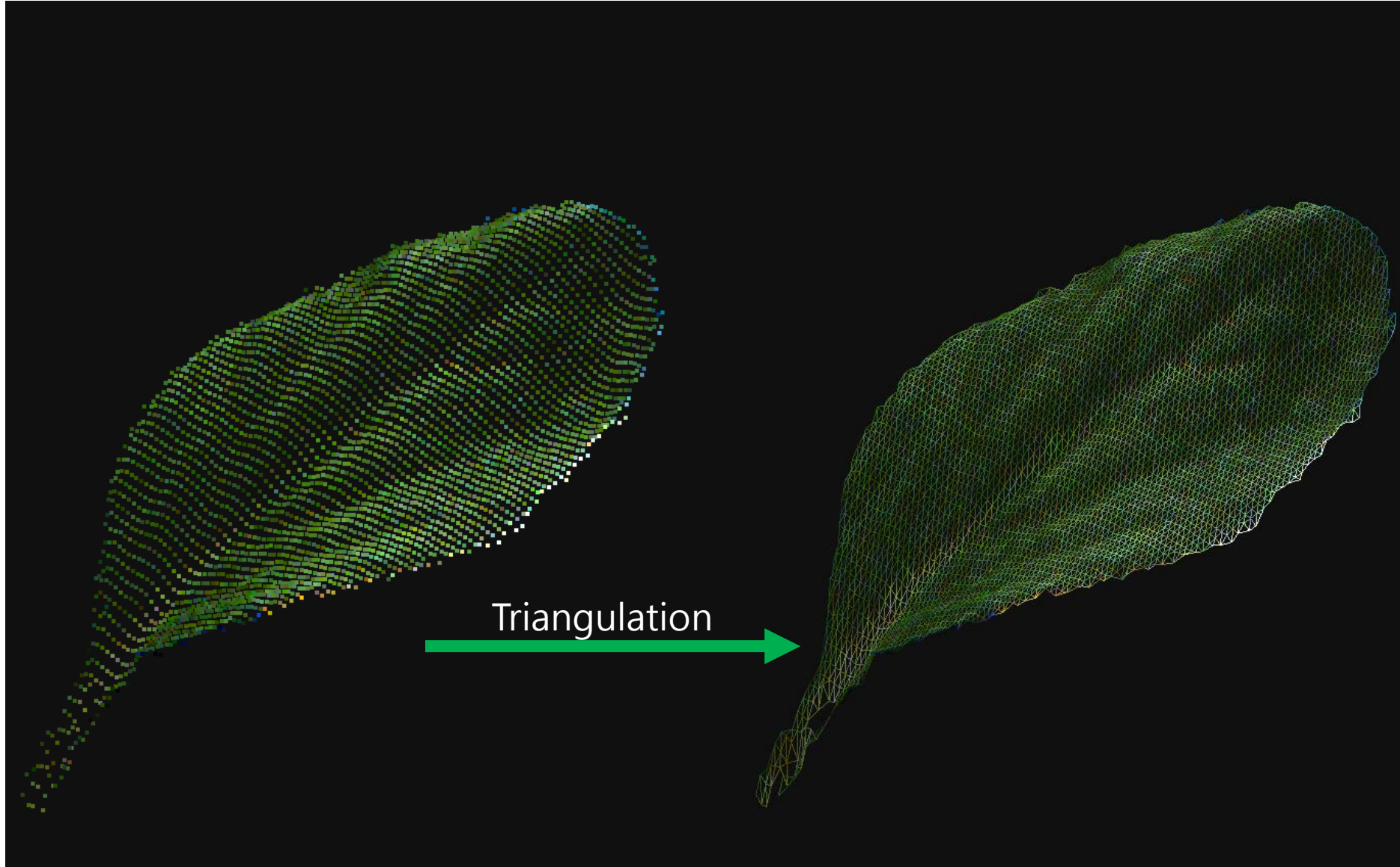
Positioning: 175 x 0

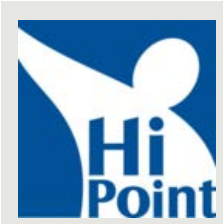
Segment



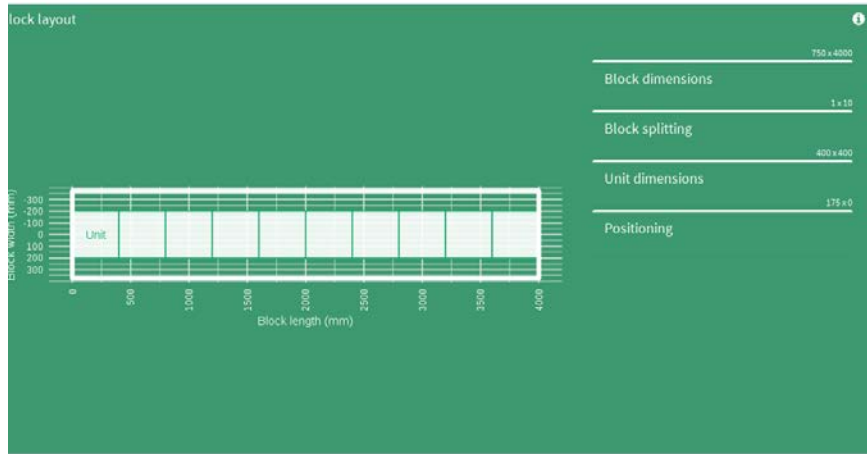


Triangulation

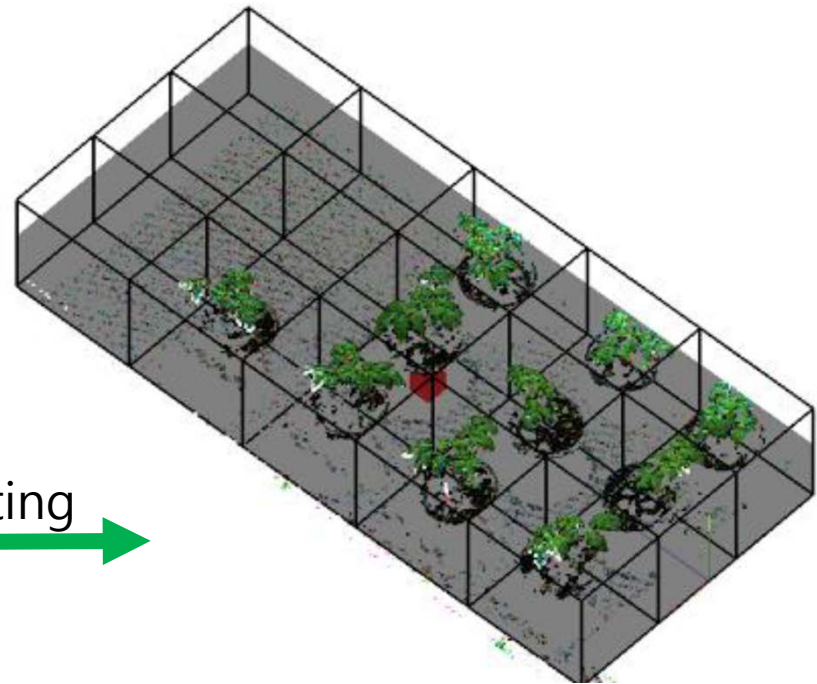




Splitting

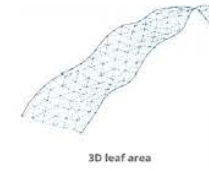
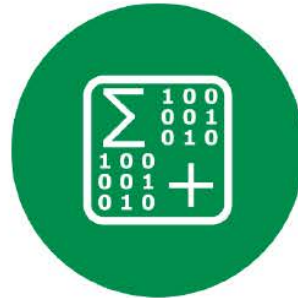


Splitting →

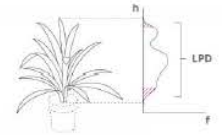




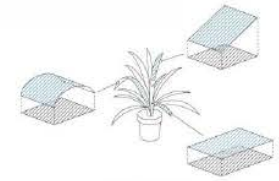
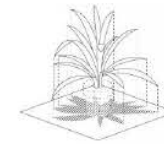
Calculate



3D leaf area

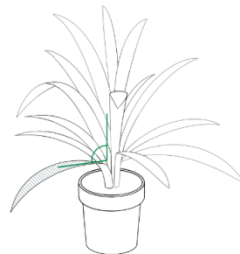


Plant height + LPD



Morphological parameter

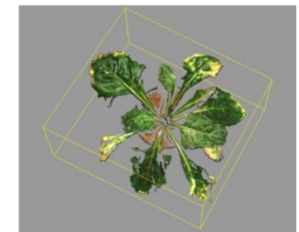
- Plant growth
- Digital biomass
- Plant height
- 3D leaf area
- Projected leaf area
- Leaf area index
- Leaf inclination
- Light penetration depth



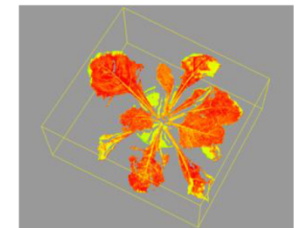
Leaf angle

Spectral parameters

- Color- & spectral analysis (Binning)
- Vegetation indices
 - NDVI
 - EVI
 - Greenness
 - NPCI
 - PSRI



RGB in 3D



Calculated Index (NDVI) in 3D

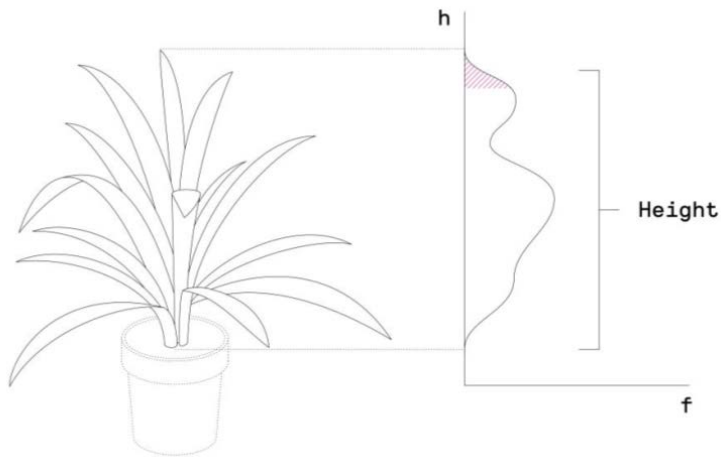


生長參數



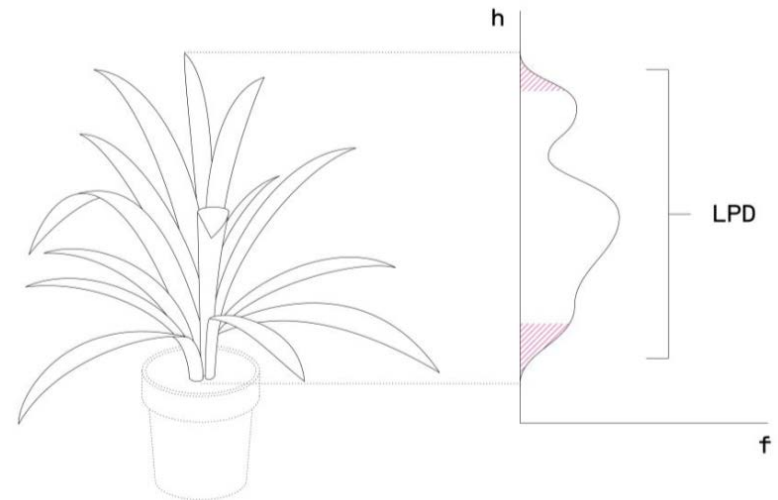
高度 (Height, H)

- 定義：掃描點Z向位置去除最大的2%點後 (避免雜訊或其他干擾物影響)，其餘98%掃描點Z向位置的高度差。
- 意義：**植物高度指標**。
- 數值範圍：0 ~ 掃描器Z向範圍
- 單位：mm



光投射深度 (Light Penetration Depth, LPD)

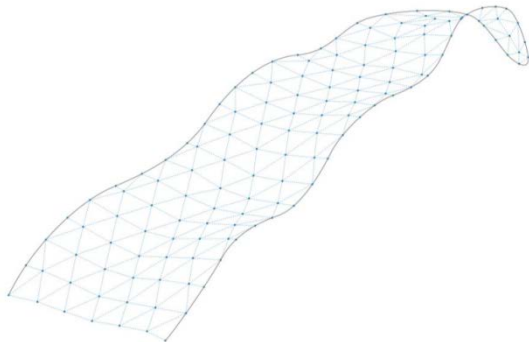
- 定義：掃描雷射光可到達的深度。
- 意義：**數值越小則代表葉片越密集，即為葉片密集度指標**。
- 數值範圍：0 ~ ∞
- 單位：mm





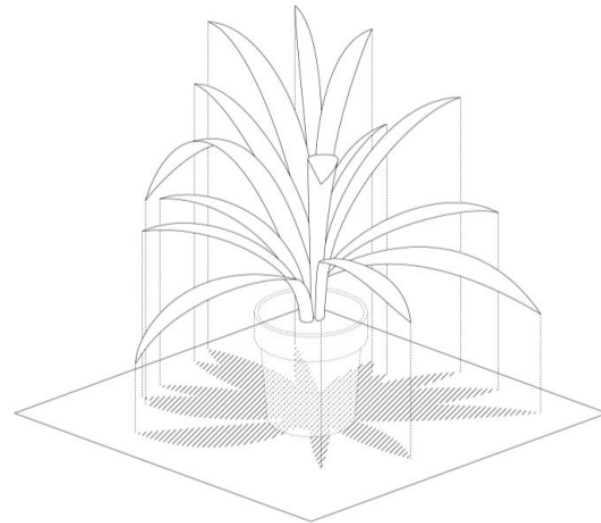
總面積 (Total Leaf Area, TLA)

- 定義：掃描點網格化(Mesh)後的所有網格面積總和。
- 意義：植物表面積。
- 數值範圍：0 ~ ∞
- 匯出檔單位：mm²



投影面積 (Projected Leaf Area, PLA)

- 定義：掃描點網格化(Mesh)投影於栽植面(XY平面)的面積。
- 意義：植物受光總面積。
- 數值範圍：0 ~ ∞
- 匯出檔單位：mm²





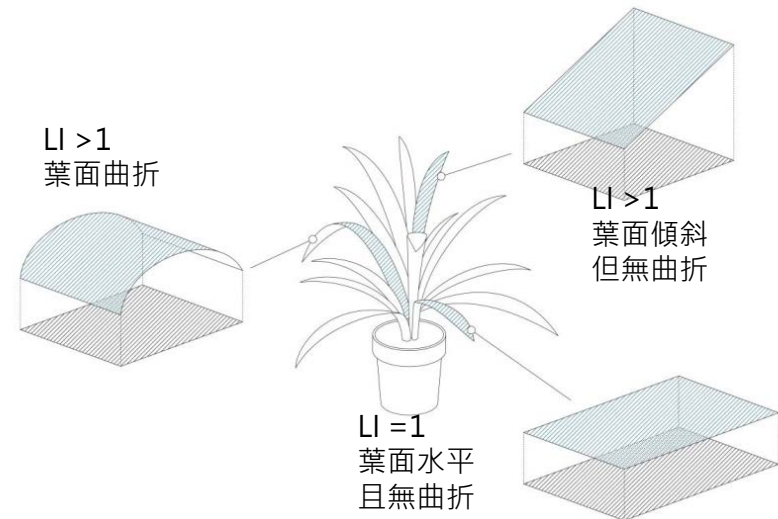
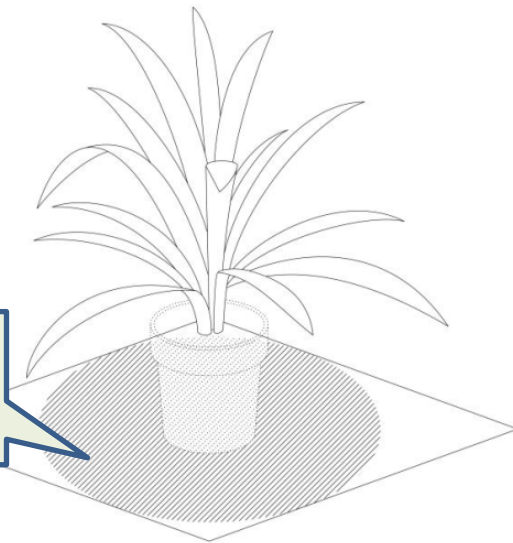
葉面積指數 (Leaf Area Index, LAI)

- 定義：投影面積佔栽種區域的比例。
- 意義：數值越大則代表植物利用栽種區的效率越高，葉片的密度越高，代表**植物對於土地的使用率**。
- 數值範圍：0 ~ ∞
- 單位：無因次
- 公式：
$$LAI = \frac{\text{總面積 (Total Leaf Area, TLA)}}{\text{栽種面積 (Sector Area)}}$$

葉面曲度 (Leaf inclination, LI)

- 定義：總面積與投影面積的比例。
- 意義：數值越大則葉面的傾斜及彎曲程度越高，為**葉形表徵**的代表參數。
- 數值範圍：1 ~ ∞
- 單位：無因次
- 公式：
$$LI = \frac{\text{總面積 (Total Leaf Area, TLA)}}{\text{投影面積 (Projected Leaf Area, PLA)}}$$

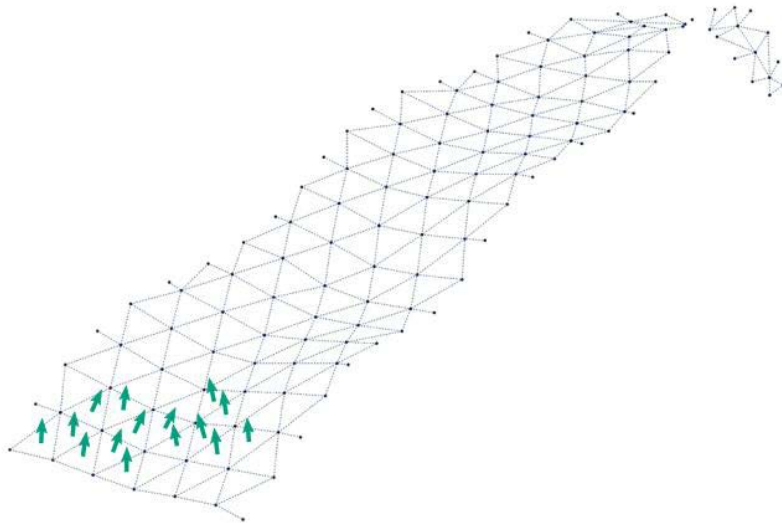
Sector :
HortContol軟體
內設定的栽種區域





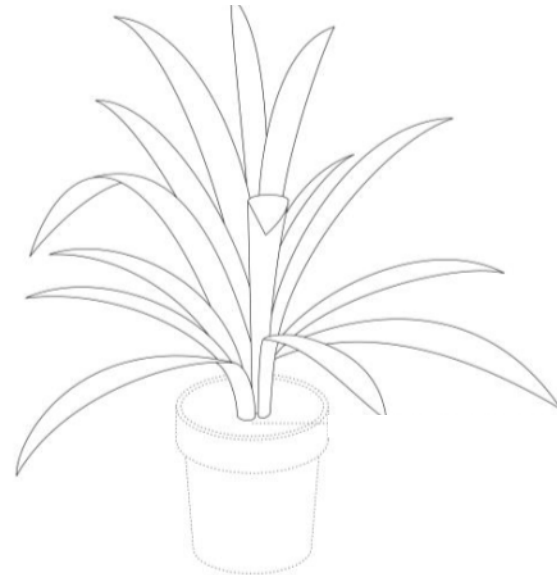
平均角度 (Leaf angle)

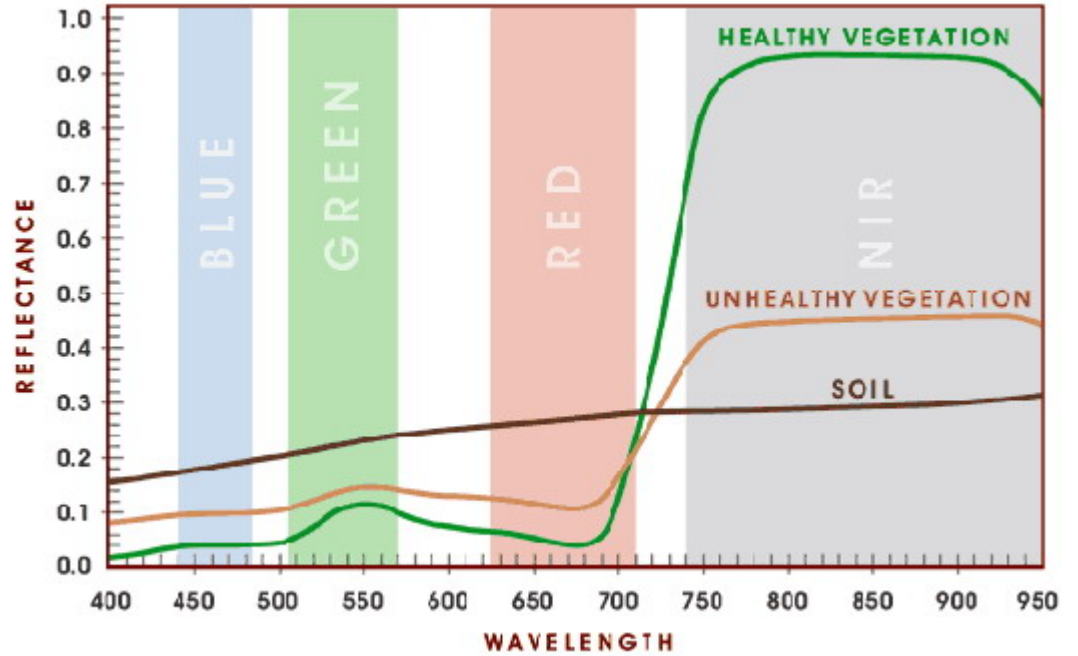
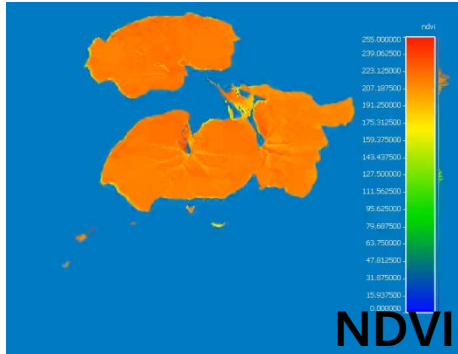
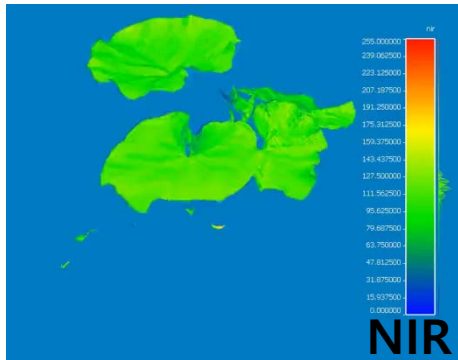
- 定義：植物表面的平均角度。
- 意義：葉角度平均值，及代表**葉片與Z軸的角度**。
- 數值範圍：0 ~ 90
- 單位：degree



體積參數 (Digital Biomass, DB)

- 定義：總表面積與植物高度的乘積。
- 意義：數值越大植物的長得越茂盛，即為**植物成長程度的綜合指標**。
- 數值範圍：0 ~ ∞
- 單位：mm³
- 公式： $LAI = \text{高度 (Height, } H) \times \text{總面積 (Total Leaf Area, TLA)}$



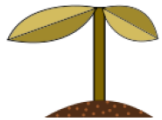
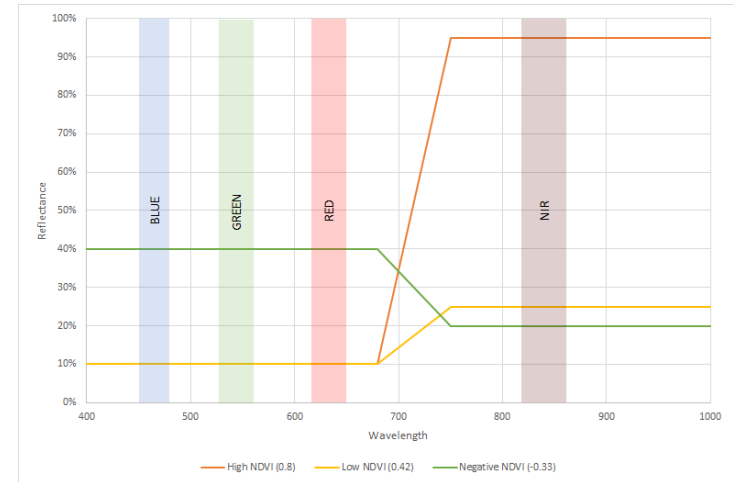


Standard wavelengths	Peak Wavelength	Spectral half-width
Red (R)	624 – 634 nm	20 nm
Green (G)	530 – 555 nm	80 nm
Blue (B)	465 – 485 nm	20 nm
Near-Infrared (NIR)	720 – 750 nm	20 nm



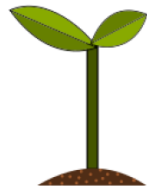
歸一化植被指數 (NDVI)

- 定義：利用紅光與近紅外光的反射，能顯示出植物生長狀況。
- 意義：**數值愈大表示植物健康度越高。**
- 數值範圍：-1 ~ 1
- 單位：無因次
- 公式：
$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$



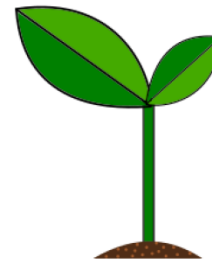
-1 - 0

dead plant or
inanimate objects



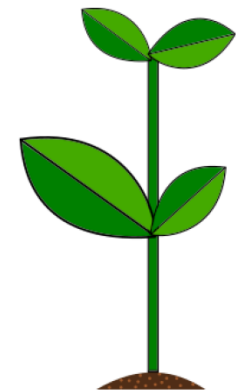
0 - 0.33

unhealthy plant



0.33 - 0.66

moderately
healthy plant



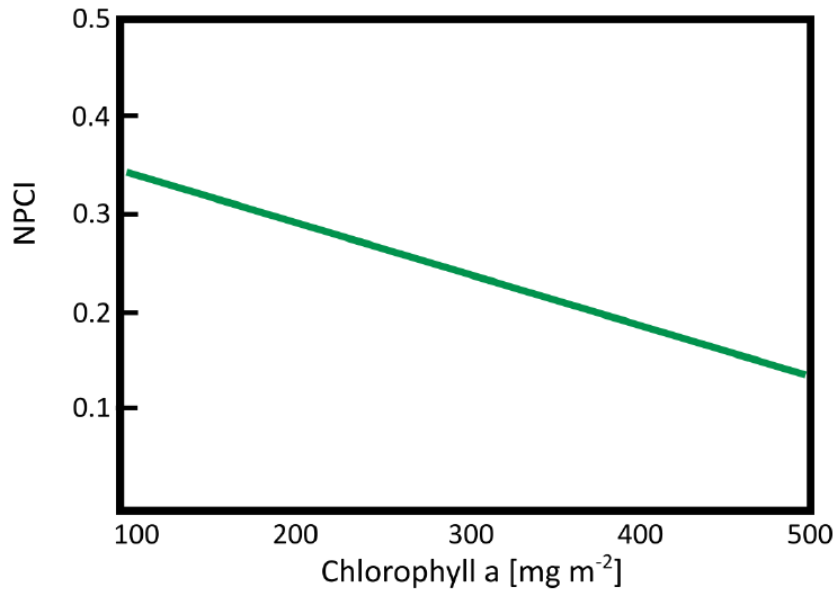
0.66 - 1

very
healthy plant



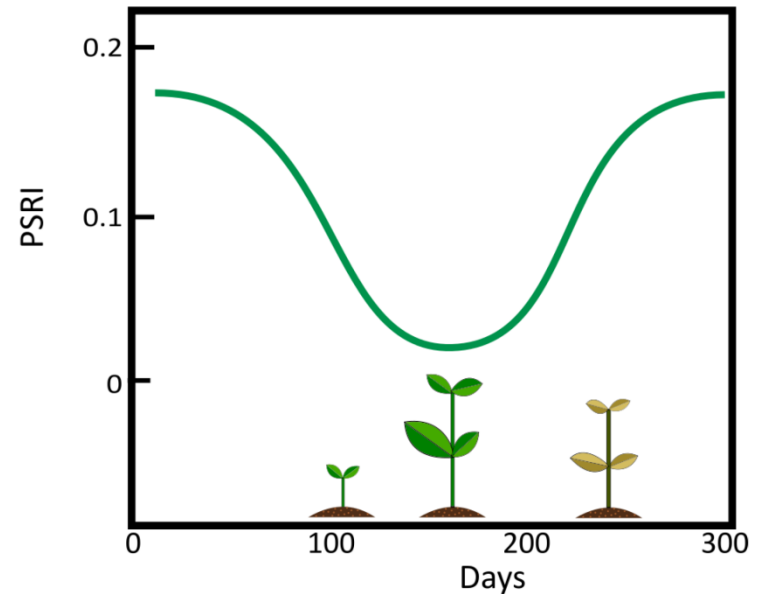
NPCI

- 定義：葉綠素濃度關係因子。
- 意義：數值愈小表示植物健康度越高。
- 數值範圍：-1 ~ 1
- 單位：無因次
- 公式： $(RED - BLUE)/(RED + BLUE)$



PSRI

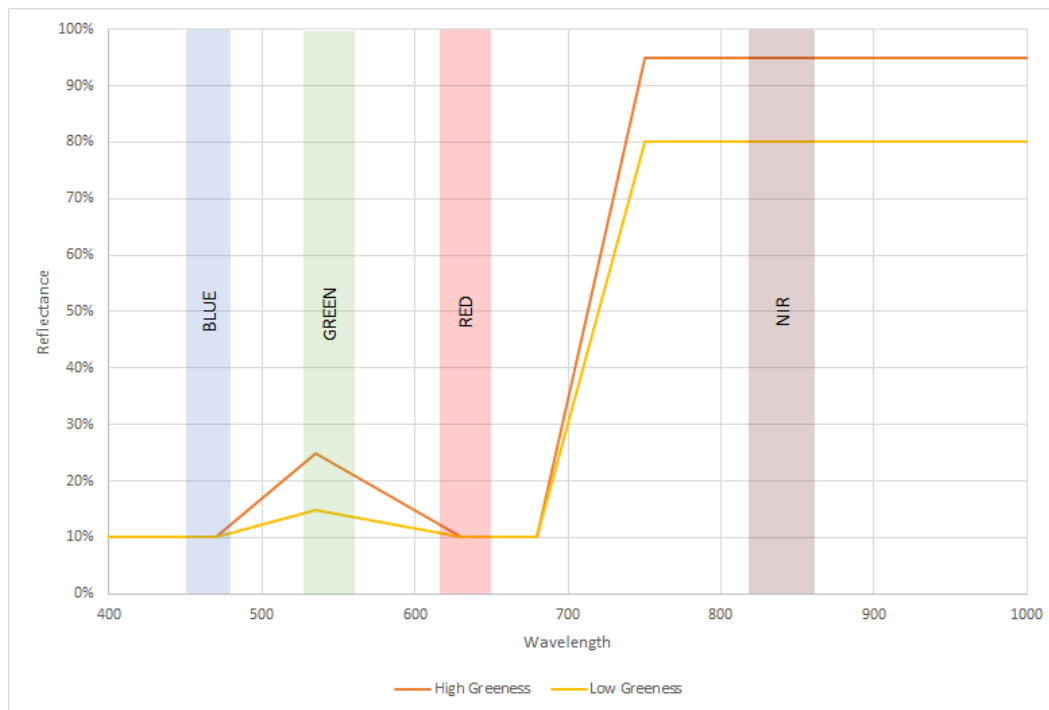
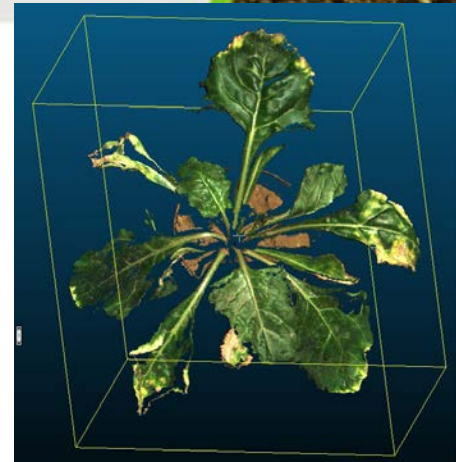
- 定義：植物衰老指數。
- 意義：數值愈小代表植物越健壯。
- 數值範圍： $-\infty \sim \infty$
- 單位：無因次
- 公式： $(RED - GREEN)/(NIR)$





綠度 (Greenness)

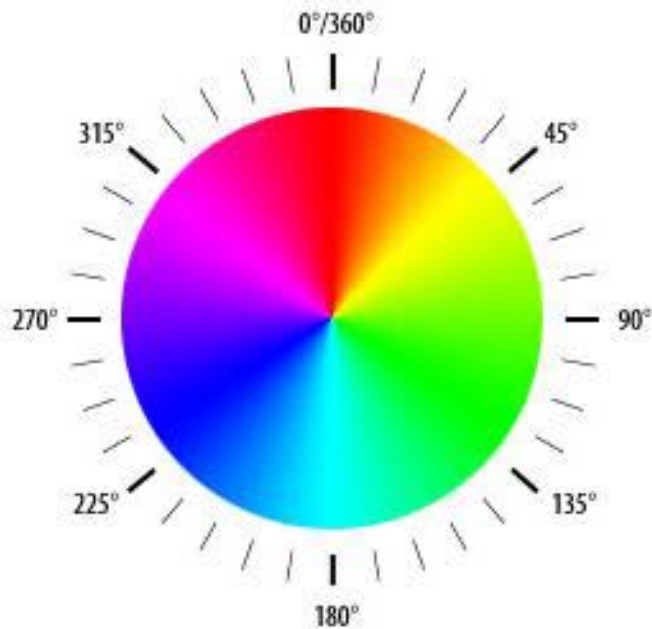
- 定義：比較植物表面的紅、綠、藍色來判斷綠色的程度。
- 意義：**數值愈大表示植物顏色越綠。**
- 數值範圍：-1 ~ 1
- 單位：無因次
- 公式： $(2 * G - R - B) / (R + G + B)$.



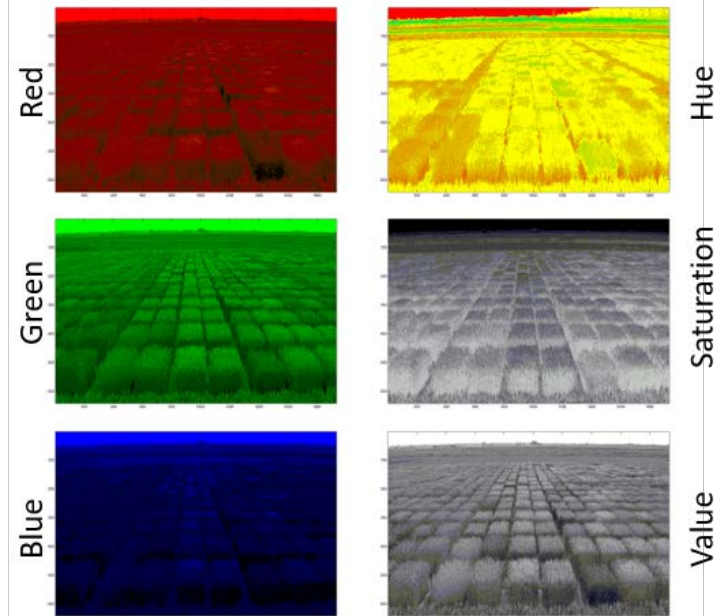
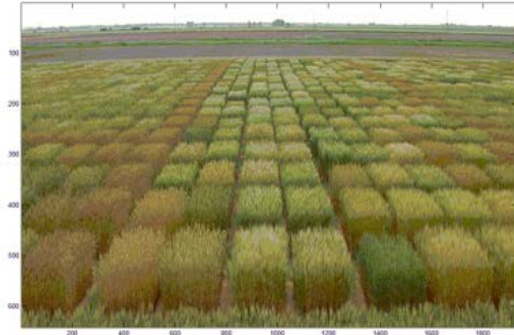


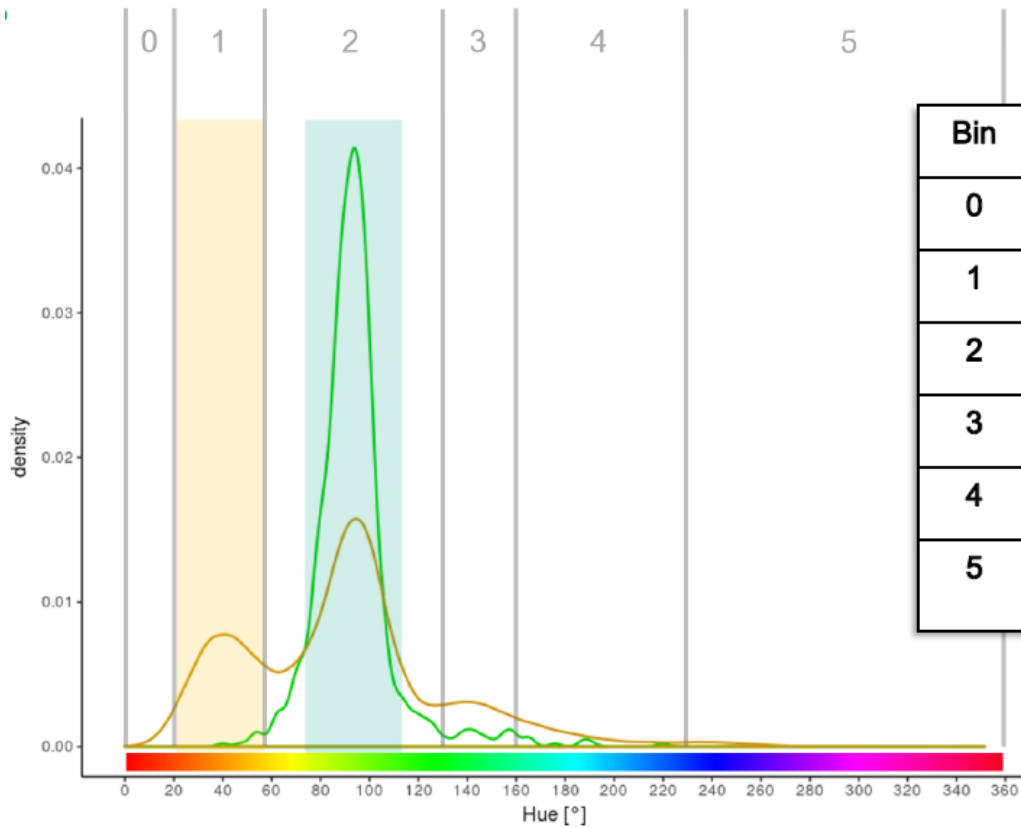
色相 (HUE)

- 定義：採用HSV中的色相 (HUE)來判定植物的顏色分布狀況。
- 意義：**代表植物的表面顏色**。
- 數值範圍：0 ~ 360
- 單位：deg



Color Image

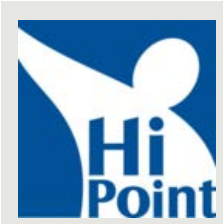




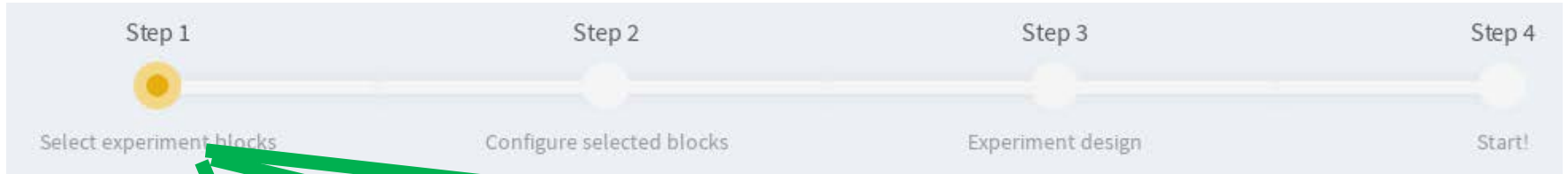
Bin	Range	Control [%]	Stressed [%]
0	0 - 20	0	0
1	20 - 60	8	16
2	60 - 130	88	75
3	130 - 160	3	4
4	160 - 230	1	4
5	230 - 360	0	0



HortControl



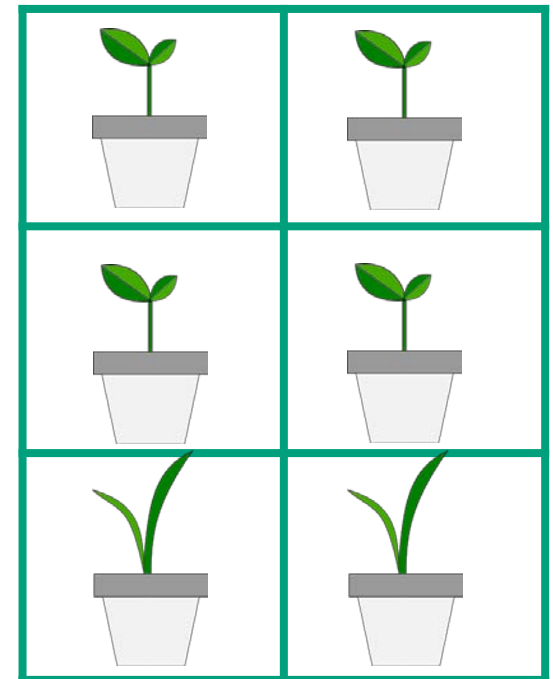
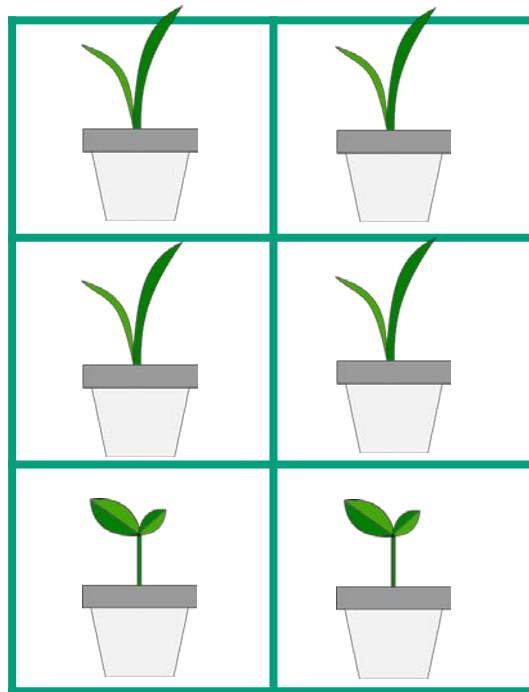
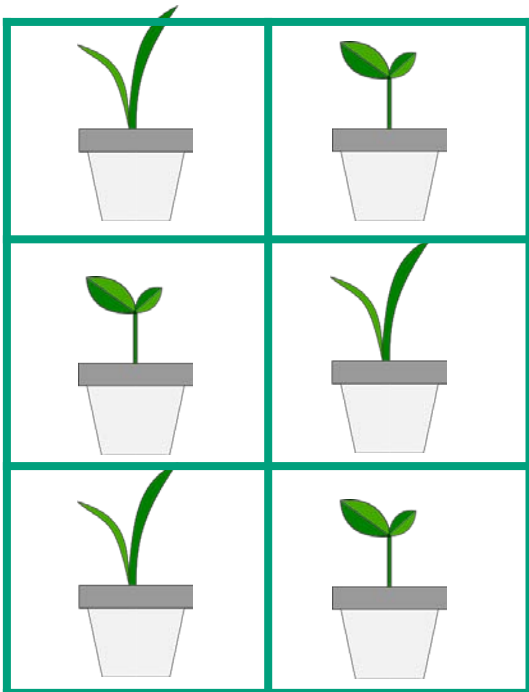
Experiments

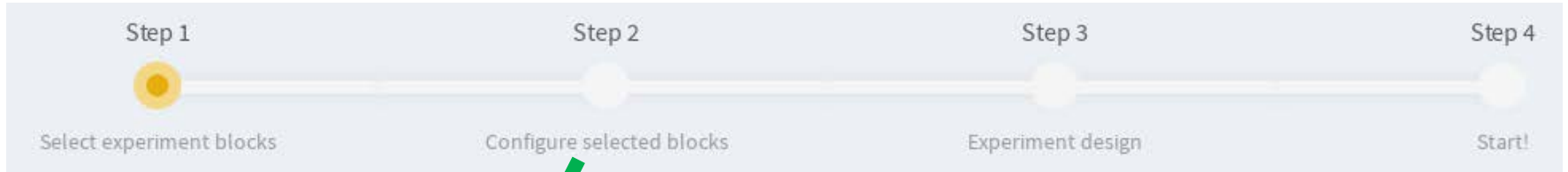


Barcode 1

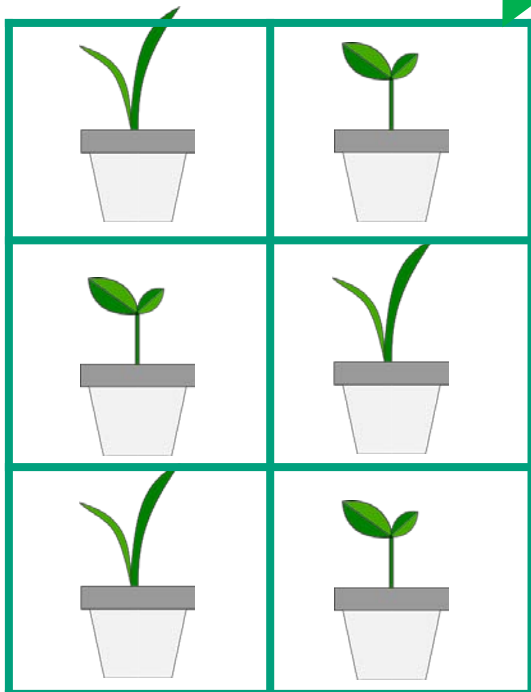
Barcode 2

Barcode 3

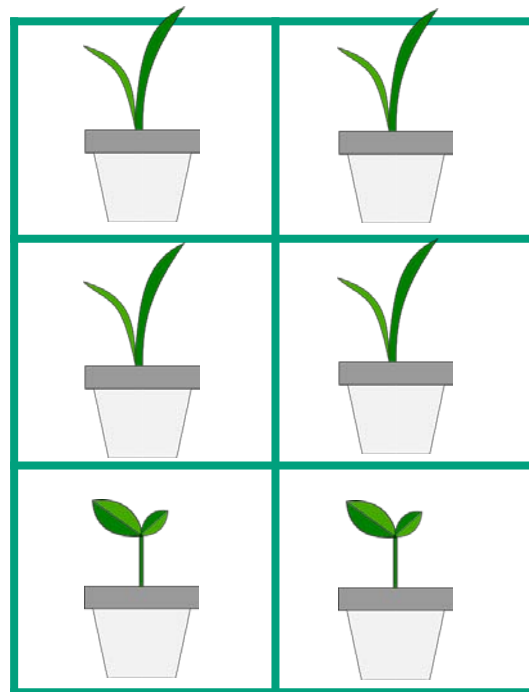




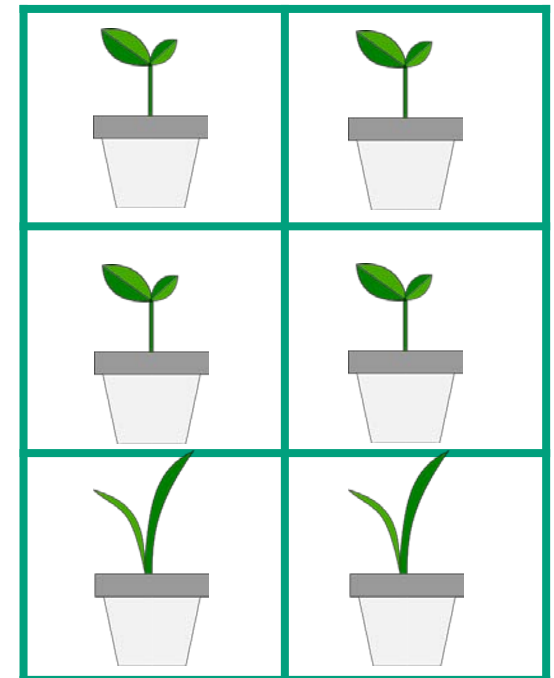
Barcode 1

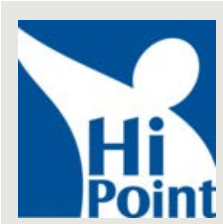


Barcode 2

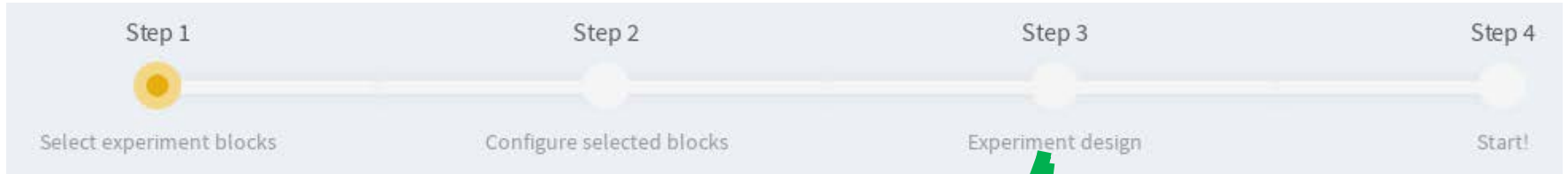


Barcode 3

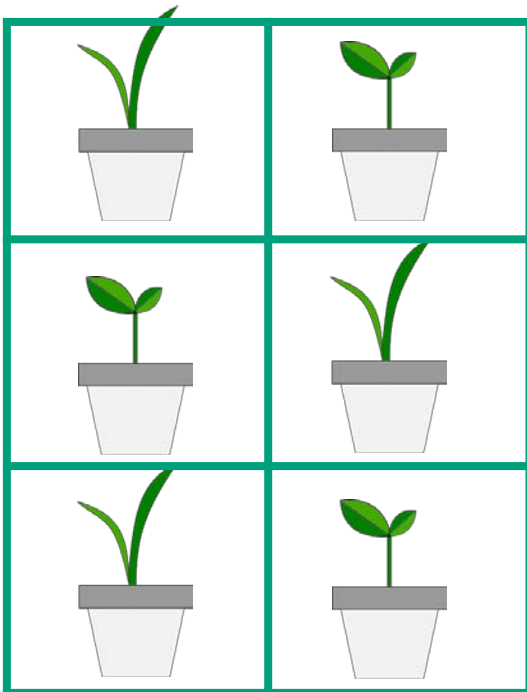




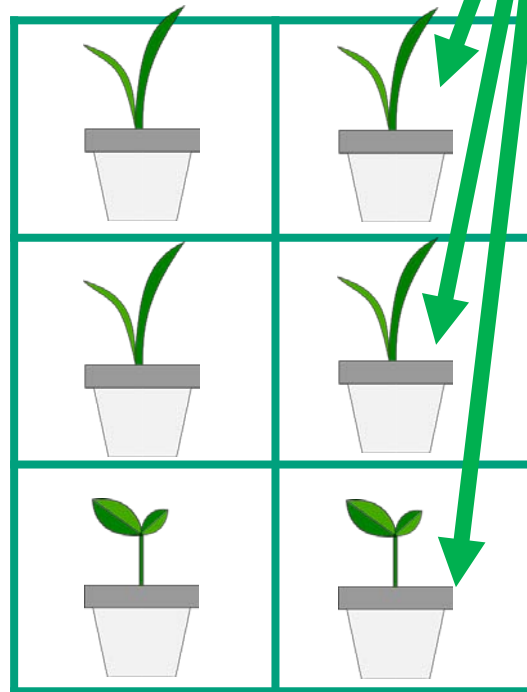
Experiments



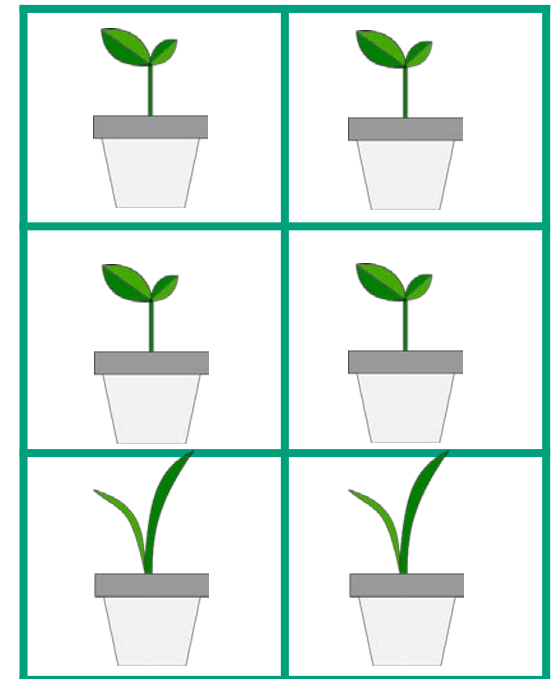
Barcode 1

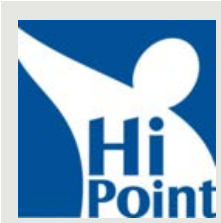


Barcode 2



Barcode 3

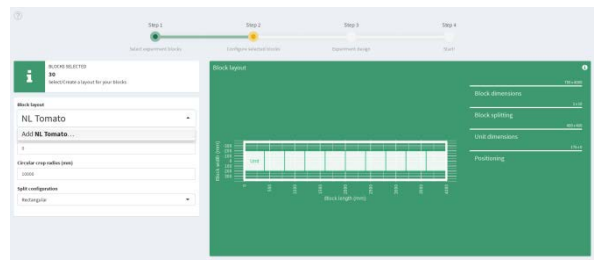




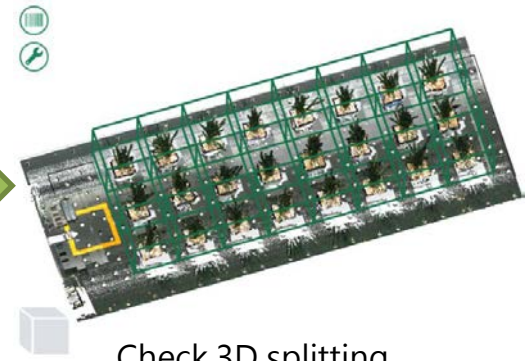
Experiments



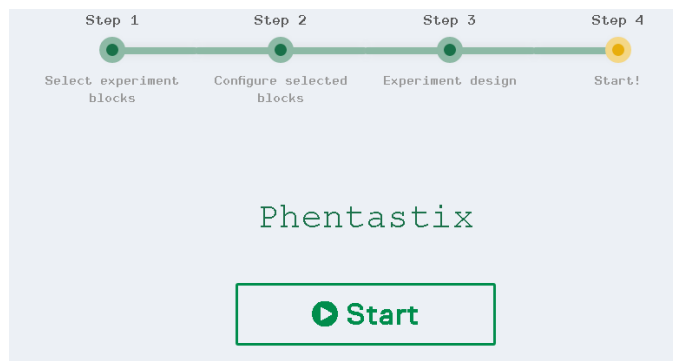
Select free blocks



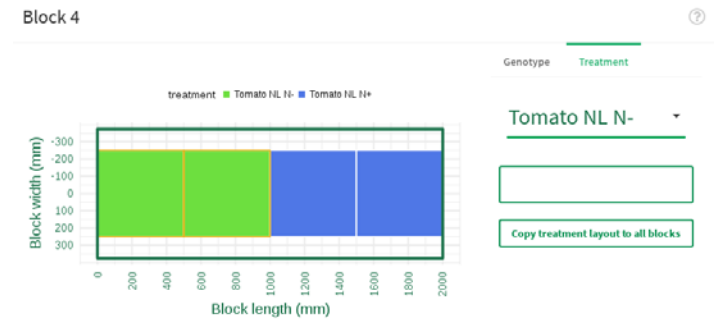
Configure Blocks



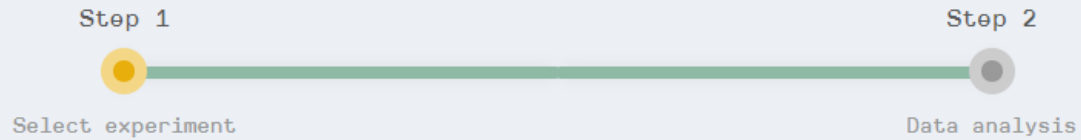
Check 3D splitting



Start



Set Metadata



Exp1

 Download

Digital biomass (mm ²)
Morphology
Digital biomass (mm ²)
Height (mm)
Leaf angle (°)
Leaf area (mm ²)
Leaf area index (mm ² /mm ²)
Leaf area (projected) (mm ²)
Leaf inclination (mm ² /mm ²)
Light penetration depth (mm)
Hue
NDVI
Greenness
NPCI
PSRI

Blocks

1

Units

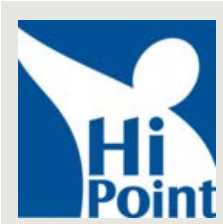
7

Sample groups

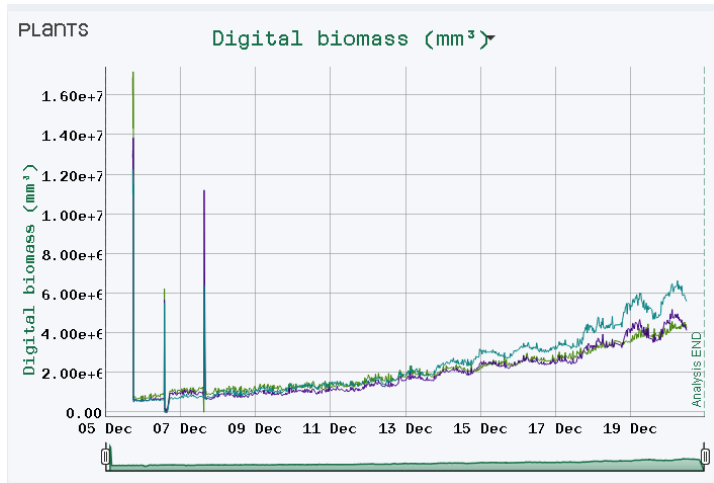
1

Sample size

7



PSX Data



Raw data

Analysis settings

- ⚙️
- 🔍
- ✍️

Analysis settings

- ▼ Data <
- 📊 Grouping <
- ⌚ Time aggregation <

Timepoints

Maximum range (h)

all ▼

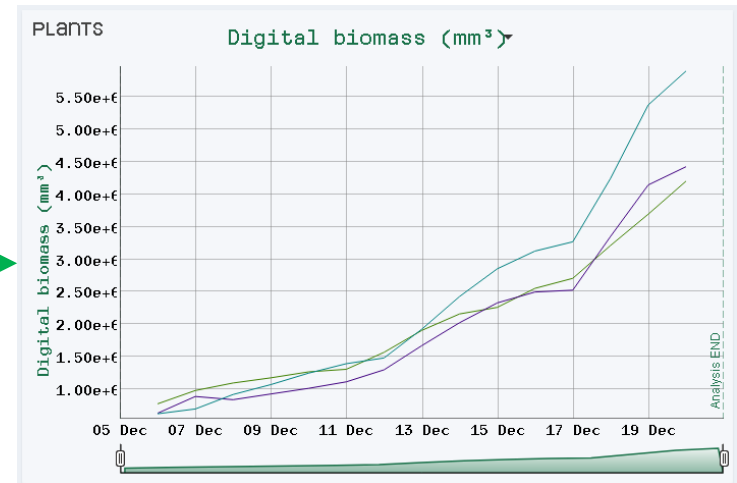
Mode

nearest ▼

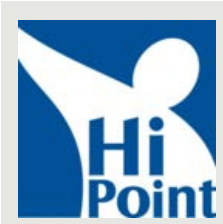
Function

median ▼

Filter
Grouping




New plot



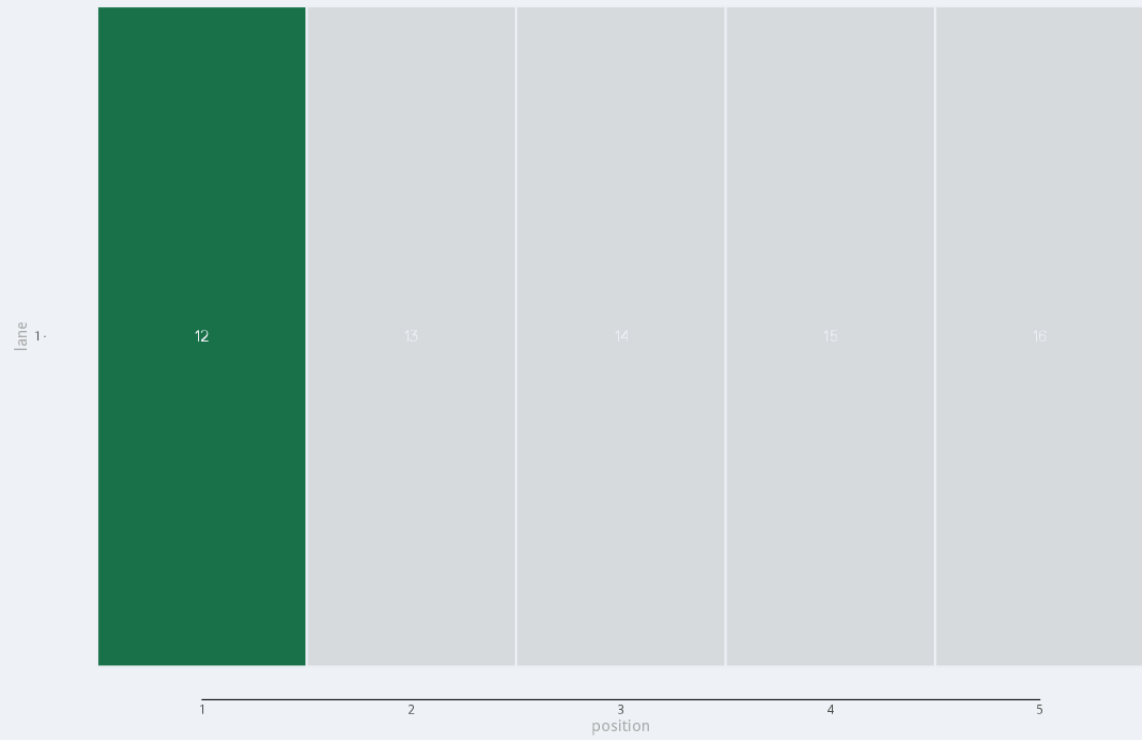
Dashboard

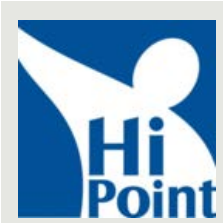


- 1 experiments active
- 1 scanners online 
- 22% disk usage


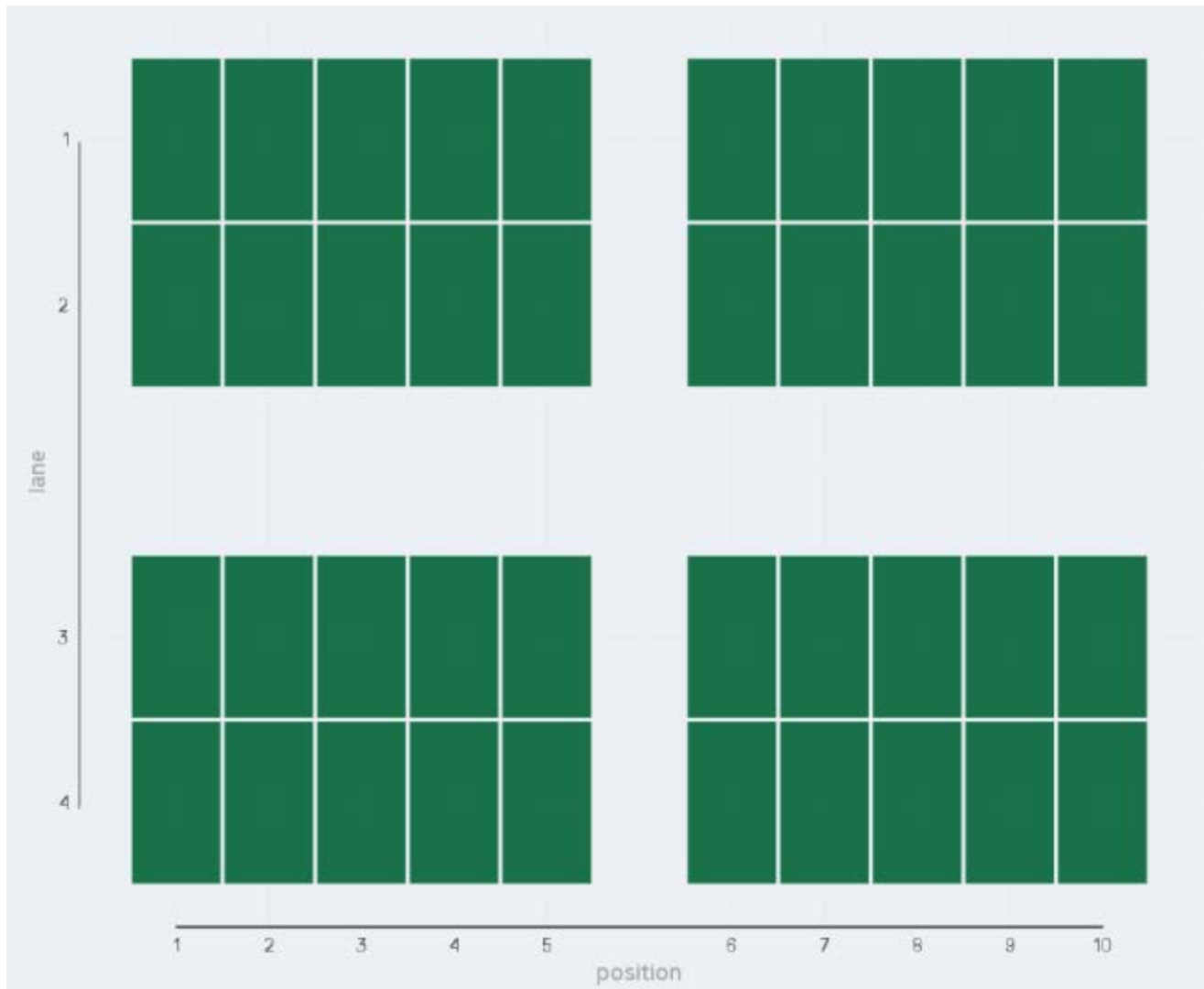
LAST scan

1 day 1 week > 1 month





System Layout configuration



CONFIGURATION

Layout <

Lanes

Blocks per lane

Add path after lane:

Add path after position:

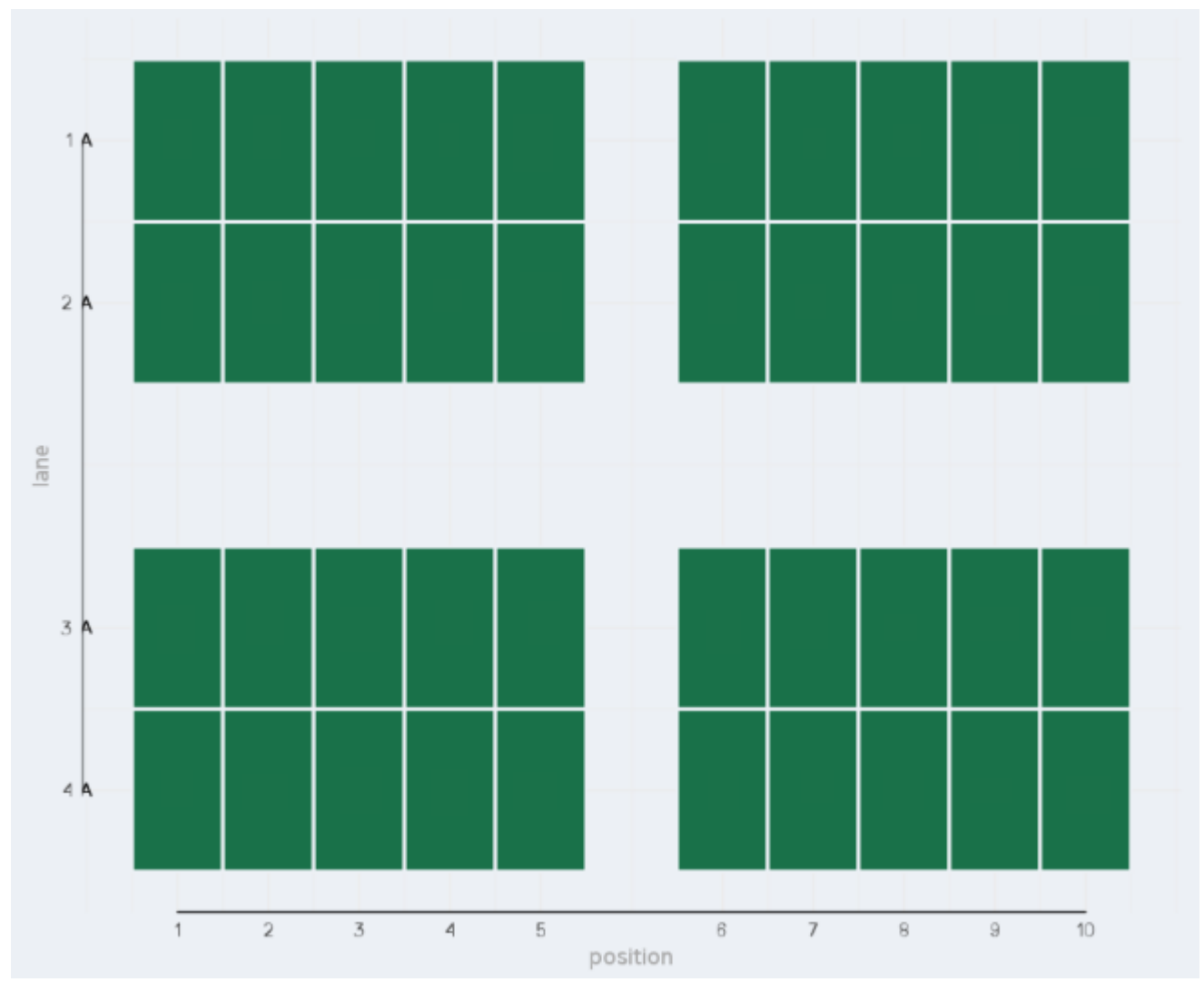
Scanners <


Barcode <

Upload layout



System Layout configuration





CONFIGURATION


- Layout <
- Scanners <

Select scanner

A ▾

Select scanner lanes

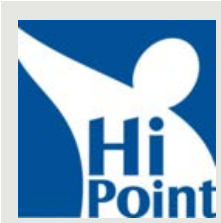
1 2 3 4 |

 Barcode <

Upload layout



系統操作



首頁



狀態列

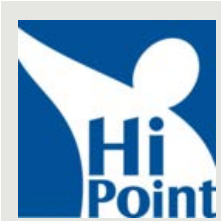
The image shows the Entoscan LT-411 software interface. At the top, it displays the Hi Point logo and the model name 'Entoscan LT-411'. Below this is a status bar with '狀態列' (Status Bar) and '目前專案' (Current Project) set to '45667'. There are five indicator lights for '異常燈' (Abnormal), '旋轉燈' (Rotation), 'Y原點' (Y Origin), 'X原點' (X Origin), and 'Z原點' (Z Origin), all of which are currently green. The main interface is divided into several sections: '專案設定' (Project Settings) with a list of projects including '45667', '45667', 'plantA', and 'plantAB'; '裝置選擇' (Device Selection) with a '雷射' (Laser) button; '龍門控制' (Gantry Control) with lens selection buttons (Len1-Len6), input fields for 'Start Point' (100), 'Interval' (3000), 'End Point' (3100), and 'hight' (10), and buttons for 'Y原點', 'X原點', 'Z原點', and '掃描'; '排程控制' (Scheduling Control) with a '天數設定' (Days Setting) of 1, '排程名稱' (Scheduling Name) of 1223, a '進度條' (Progress Bar) from 0 to 3, and a 'START' button. A '排程資料' (Scheduling Data) table is also present. At the bottom, there are buttons for '停止' (Stop), '首頁' (Home), '警報' (Alarm), '專案管理' (Project Management), '熱點設定' (Hotspot Setting), and '關閉' (Close).

專案管理
裝置設定

手動操作

自動排程操作

頁面切換



警報頁面

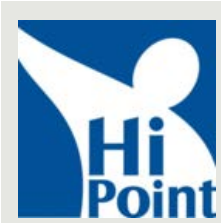


The screenshot displays the Entoscan LT-411 control panel interface. At the top, the Hi Point logo and 'Entoscan LT-411' are visible. Below this, the '狀態列' (Status Bar) shows '目前專案' (Current Project) as '45667' and five indicator lights for '異常燈' (Abnormal), '旋轉燈' (Rotation), 'Y原點' (Y Origin), 'X原點' (X Origin), and 'Z原點' (Z Origin). The '警示燈' (Warning Lights) section contains nine lights labeled 'X-', 'X+', 'Y-', 'Y+', 'Z-', 'Z+', 'X軸', 'Y軸', and 'Z軸'. The '維修控制' (Maintenance Control) section includes an 'OK' button and a 3D coordinate system with 'Forward', 'Back', 'Left', 'Right', 'Up', and 'Down' buttons. The '警報' (Alarm) section at the bottom has a '初始化設定' (Initialize Settings) button. A bottom navigation bar contains buttons for '停止' (Stop), '首頁' (Home), '警報' (Alarm), '專案管理' (Project Management), '熱點設定' (Hotspot Settings), and '關閉' (Close).

顯示燈警示

手動排除警報

初始化設定



專案管理頁面



Hi Point EntoScan LT-411

狀態列 目前專案 plantA 異常燈 運轉燈 X原點 Y原點 Z原點

排程設定

	TIME	LEN	LASER/FIR	
01234	16:30	1,2,3,5,6	LASER	新增
012345	16:32	1,2,3,4,5,6	FIR	刪除
0123456	18:46	1,2,3	LASER	

時間選擇 頁 00 分 00 相機選擇 LASER FLIR

Start Point Interval End Point

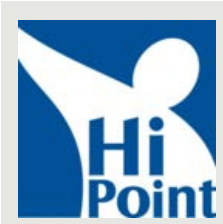
Settings	Len1	Len2	Len3	Len4	Len5	Len6
Start Point	110	100	100	100	100	100
Interval	100	100	100	100	100	100
End Point	3000	3000	3000	3000	3000	3000
high	10	10	10	10	10	10

停止 首頁 警報 專案管理 熱感設定 關閉

專案列表

排程設定

掃描參數調整



緊急停止步驟



如機器正在運轉中，遇到任何需強制關閉機器的情況時，可參考以下步驟：

1. 在軟體內按下緊急停止按鈕，並且按下配電箱上紅色按鈕。
2. 按下配電箱上綠色按鈕，將機器斷電。
3. 若移動軸超出正常運行範圍，在按下綠色按鈕斷電後可手動將移動軸恢復至正常位置。
4. 確定外部無阻擋物後，再次按下綠色按鈕重新啟動。

THANK YOU

GRACIAS
ARIGATO
SHUKURIA
JUSPAXAR

BIYAN
SHUKRIA

TASHAKKUR ATU
YAQHANYELAY
SUKSAMA
EKHMET
GRAZIE
MEHRBANI
PALDIES
BOLZIN
MERCI

DANKSCHEEN
SPASSIBO
SNACHALHUYA
NUHUN
CHALTU
WABEEJA
MAITEKA
HUI
YUSPAGARATAM
UNALCHEESI
ATTO
ANRHA
MERASTAWHY
SANCO
MAAKE
LAH
SAKOMO
MAKETAI
MINMONCHAR
TINGKI
HATUR GI
EKOJU
SPASIBO
DENKAUJA
HEHACHALHYA
TAVTAPUCHI
MEDAWAGSE
BAIKA
GOZAIMASHITA
AGUYJE
FAKAAUE
KOMAPSUMNIDA
FAKAUE