



# **CANOPYAI**XPERT

The Multi-Sensor Phenotyping System for Canopies

LemnaTec Customized Solutions for Phenotyping

Manufactured by LemnaTec, distributed in the UK and Ireland by **analytik**.

# **CANOPYAI**XPERT

### The Sensor-to-Plant Phenotyping System for Greenhouses and Growth Rooms

- Versatile instrument
- Broad range of phenotyping applications
- Plant-environment-interactions
- Genotype-phenotype-relations
- For research and breeding
- Imaging and analyses of plants in pots, containers, or ground soil
- Sensors moved across planting area
- Canopy-level data
- Plant-level data if plants do not overlap
- Multi-sensor phenotyping
- Advanced machine learning for feature extraction
- Database for plant data and metadata



### **Features**

High-resolution plant phenotyping Available for glasshouses and closed climate rooms Experiment planning and automated measuring Sensors unified in measuring head or sensor exchange system

### **Product Properties**

### Gantry system

- X-Y or X-Y-Z movement
- Full automation
- Scalable design for various room sizes
- Rapid data acquisition
- Flexible design of experiments

#### Sensor options – top view cameras

- Visible light/RGB camera module
- Near infrared (NIR) camera module
- Infrared (IR) camera module
- Chlorophyll Fluorescence Kinetics module
- > Hyperspectral imaging module
- Multispectral imaging module
- Laser scanner

### Modular Building Set with Three Application-Oriented Designs

The LemnaTec CanopyAlxpert is available in three models and can easily be customised to your needs.

### Model Type 1, Y-Z Moving Carrier System

Model type 1 is a system for non-scanning cameras mounted in fixed positions on the carrier system.





- Carrier system installed on adjustable framework in greenhouse
- Top-down working method
- Solution Moveable X-Axis based on timing belt drive
- Length up to 25 m
- Suitable for non-scanning cameras (e.g., RGB, IR)
- > Y-Axis up to 8 m length. (Optional)
- Z-Axis up to 2 m length. (Optional)

## Model Type 2, X-Y-Z Moving Carrier System

Model type 2 is a system for scanning and non-scanning cameras mounted as exchangeable sensors on the carrier system. It works in combination with the LemnaTec Sensor Exchange Station System. The system has an adjustable Z-axis for different sensor types and different plant heights. The sensor and the Y-axis are moved together in Z-direction to adjust imaging height and prevent collisions with taller plants.





- Carrier system installed on adjustable framework in greenhouse
- Top-down working method
- X-Y-Z-Gantry system based on linear axes
- X-Axis up to 8.5 m length
- > Y-Axis up to 8 m length

- > Z-Axis up to 2 m length
- Suitable for static and scanning sensors (e.g., RGB, IR, hyperspectral cameras, 3D laser scanner ...)
- Sensor exchange station optional for fully automated operation with different cameras/sensors

### Model Type 3, Compact X-Y-Z Moving Carrier System for Climate Chambers

Model type 3 is a system for scanning and non-scanning cameras mounted as exchangeable sensors on the carrier system. It works in combination with the LemnaTec Sensor

Exchange Station System. It is a compact system that particularly fits into climate-controlled chambers.



- Carrier system installed on adjustable framework in greenhouse
- Top-down working method
- Suitable for climate-controlled chambers
- X-Y-Z-Gantry system based on linear axes
- X-Axis up to 8.5 m length
- X-Axis for wall mount or on pillars

- > Y-Axis up to 8 m length
- Z-Axis up to 2 m length
- Suitable for static and scanning sensors (e.g., RGB, IR, hyperspectral cameras, 3D laser scanner ...)
- Sensor exchange station optional for fully automated operation with different cameras/sensors

### Software

The CanopyAlxpert is delivered with a comprehensive software package. The software provides all possibilities of system control so that users can provide sample information and program a complete workflow for the samples. Users can define the samples loaded into the system, and give information such as species, genotype, treatment, or

After imaging all data are stored and accessible for image and data processing. With LemnaGrid, we provide a userprogrammable image processing toolbox that allows for analyzing the recorded image data. LemnaGrid comprises other grouping parameters. For all available cameras, users can determine which imaging principles are used with the loaded samples – full set or selected sub-set – and make the essential settings such as exposure, white balance, and more.

a large library of functions to handle, analyze, and process various types of image data. By combining functions on a graphical surface, users can establish analytical workflows.



In addition, we offer the development of customized analyses for user-generated images, including machine learning procedures.

The LemnaAlxplorer enables access to and visualization of all images, analyses, and related data. Tabulating and plotting functions are available together with image browsing. All data can be exported as CSV files or directly delivered to standard data bases.

	20211-1 2 2 4																- 0
- + C & -	- 100% + 0 D local	host 5000														0 .	
																	Transition of
Summary	Experiment Dat	aTable	Image Gallery	Plots													? 8
perments Rice																	
Experiment Der	scription						1	Image Gallery								<	10/31 >
end Germination A	calvais of rice seeds							Contraction of the local division of the loc	1	1	1	1	1	1	1		1
								1000					1000				
																-	-
										1000					1.12	1.32	
								COLUMN DOCUM									
								COLUMN TWO IS NOT								1000	
											_					_	
										1							
Data Table						< 8-12/1	1550 3	Example Plot							tomatic Typ	e (Line Pio	- -
teta Table † Experiment	Workflow	Sample ID	Time Stamp	Cultivar	Position	C 0-12//	1560 D Root *	Example Plot Root Length	• 600						formatic Typ	e (Line Pio	a) •
DetaTable • Experiment • Rice	Workflow Rox_Germator_Analysis	Sample ID 1405	Time Blamp 2019-05-06 10 37 32	Cultivar Type2018	Position A01	germinated	1500 > Reot * 204	Example Plot Root Length	100						formatic Tyr	e (Line Pio	0 •
ostaTable I Experiment Ros Ros	Workflow Res_Germation_Anayse Res_Germation_Anayse	Sample ID 1405 1405	Time Stamp 2019-05-05-10-37-32 2019-05-06-10-37-32	Cultivar Type2015 Type2015	Position A01 A02	germinated 1	1550 > Root * 204 238	Example Plot Root Length Grouped By	1 600 800						dosmatic Typ	e (Line Pic	0 ·
DetaTable F Experiment Ros Ros Ros	Workflow Roce, Germanton, Analysis Roce, Germanton, Analysis Roce, Germanton, Analysis	Sample ID 1405 1405	Time Stamp 2019-05-06 10 37 32 2019-05-06 10 37 32 2019-05-06 10 37 32	Cultivar Type2018 Type2018 Type2018	Position A21 A22 A23	germinated 1	1550 > Root * 204 238	Example Plot Root Length Grouped By None	1 600 800 800						tomatic Typ	n (Line Po	
nota Table F Experiment Rice Rice Rice Rice	Workfleer Rice_Germation_Maryss Rice_Germation_Maryss Rice_Germation_Anayss Rice_Germation_Anayss	Sample ID 1408 1408 1408 1408	Time Stamp 2019-65-06 10 37 32 2019-65-06 10 37 32 2019-65-06 10 37 32 2019-65-06 10 37 32	Cultiver Type2015 Type2015 Type2015 Type2015	Position A01 A02 A03 A04	germinated 1 1	204 236 236 383	Example Flot Root Length Grouped By None *	1 600 600 600							e (Line Po	
DetaTable F Experiment Rice Rice Rice Rice Rice Rice	Workflow Rice_Germator_Maryss Rice_Germator_Maryss Rice_Germator_Analyss Rice_Germator_Analyss Rice_Germator_Analyss	Semple ID 1408 1408 1408 1408 1409	Time Stamp 2019-65-06 10 57 32 2019-65-06 10 57 32 2019-65-06 10 57 32 2019-65-06 10 57 32	Cultivar Type2016 Type2018 Type2018 Type2018 Type2018	Position A01 A02 A03 A04 A25	Cartonicated	204 204 208 983 129	Example Piot Root Length Grouped By None •	2 600 600 600 500							n (Line Pro	
PotaTable F Experiment Roce Roce Roce Roce Roce Roce	Workflow Rise, Germanton, Anayos Rise, Germanton, Anayos Rise, Germanton, Anayos Rise, Germanton, Anayos Rise, Germanton, Anayos	Semple ID 1408 1408 1408 1409 1409 1409 1409	Time Stamp 2019-05-05 10:57 32 2019-05-06 10:57 32 2019-05-06 10:57 32 2019-05-06 10:57 32 2019-05-06 10:57 32	Cultivar Type2018 Type2018 Type2018 Type2018 Type2018	Position A01 A02 A03 A04 A05 B01	C 0-12// perminated 1 1 1 1 1 1	8500 > Root * 204 238 483 128 238	Example Plot Root Length Grouped By None •	<ul> <li>600</li> <li>800</li> <li>800</li> <li>800</li> <li>800</li> </ul>							n (Line Pro	
Data Table <b>F Experiment</b> None 1 None 2 None 2 None 4 None 4 None 5 None 5 None 5 None 6 None	Workfleer Rote, Germanton, Analysis Rote, Germanton, Analysis Rote, Germanton, Analysis Rote, Germanton, Analysis Rote, Germanton, Analysis Rote, Germanton, Analysis	Sample ID 1400 1408 1408 1409 1409 1409	Time Stamp 2019-05-06 10-17-32 2019-06-06 10-17-32 2019-05-06 10-17-32 2019-05-06 10-17-32 2019-05-06 10-17-32 2019-05-06 10-17-32	Cultiver Type2018 Type2018 Type2018 Type2018 Type2018 Type2018 Type2018	Position A01 A03 A04 A05 B01 B02	C CLI271 germinated 1 1 1 1 1 1 1	8500         >           Root         *           204         *           208         *           983         *           128         *           94         *	Example Plot Root Length Grazed By None •	• 500 500 400 300 300							+ (Las Pa	
Data Table F Experiment D Ros 1 Ros 2 Ros 5 Ros 5 Ros 5 Ros 5 Ros 5 Ros 6 Ros 6 Ros 6 Ros 6 Ros 6 Ros 7 Ro	Workflow Rice_Germator_Arayss Rice_Germator_Arayss Rice_Germator_Arayse Rice_Germator_Arayse Rice_Germator_Arayse Rice_Germator_Arayse Rice_Germator_Arayse	Sample ID 1400 1408 1408 1408 1408 1409 1409 1409	Time Stamp 2019-55 (4):03.17.22 2019-65 (6):05.17.22 2019-65 (6):05.7.22 2019-65 (6):05.7.22 2019-65 (6):05.7.22 2019-65 (6):05.7.22 2019-65 (6):05.7.22	Cultivar Type2018 Type2018 Type2018 Type2018 Type2018 Type2018 Type2018	Position A01 A02 A03 A04 A05 801 802 803	C C C C C C C C C C C C C C C C C C C	Boot         Image: Constraint of the second se	Example Piot Root Length Grouped By None •	* 400 400 400 300 300 100							a (Lina Pic	