

植物表型最新应用与AgriPheno表型平台 科研项目成果分享

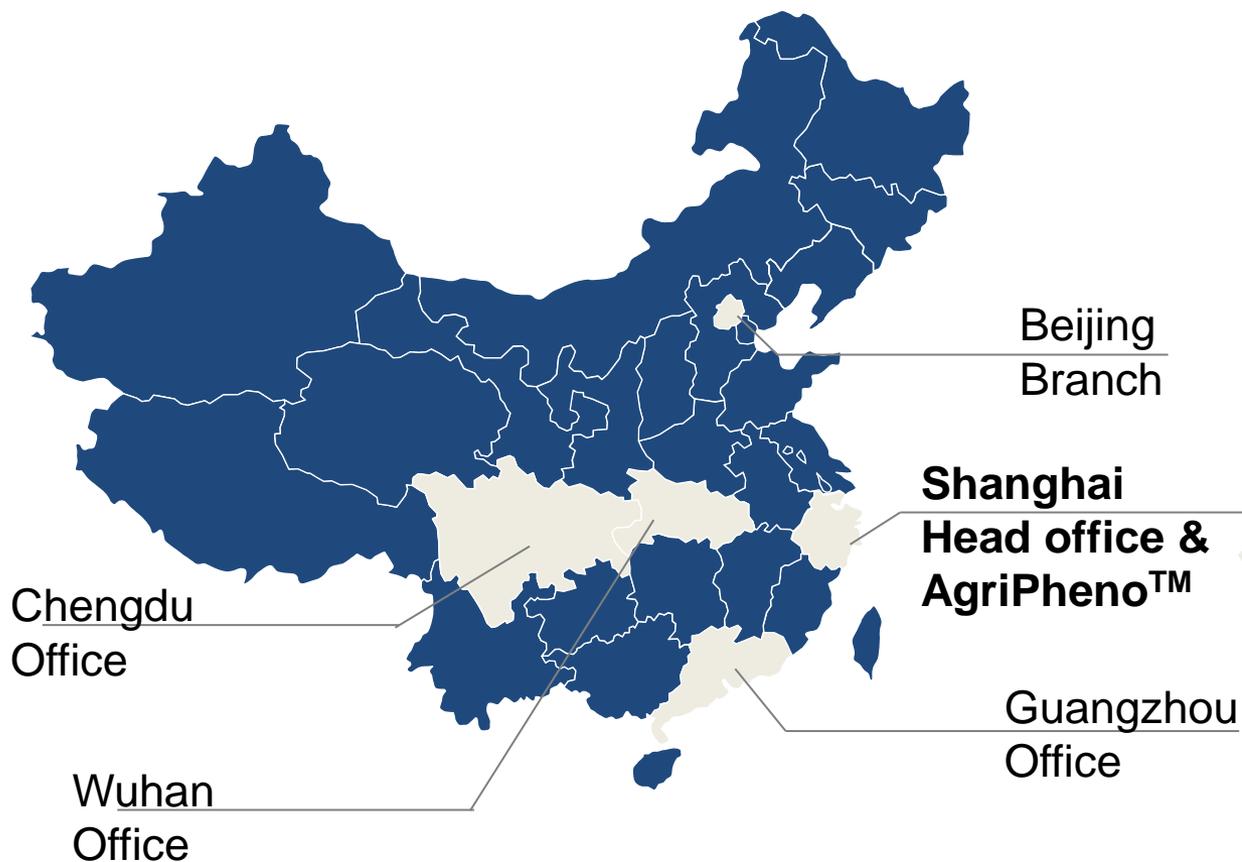
张弘

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上海泽泉科技股份有限公司
上海乾菲诺农业科技有限公司

Zealquest Scientific Technology Co., Ltd.
Zealquest AgriPheno Co., Ltd.

About Us



- National
Certificated High-Tech Enterprises
 - More than 80% of technicians and sales representatives have MSc or Ph.D degree
 - High throughput plant phenotyping platform
- AgriPheno™



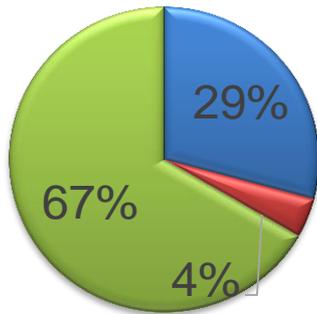
About AgriPheno™ Platform

- Set up in 2014, belong to Zealquest Scientific Technology Co.,Ltd
- The First High throughput plant phenotyping-genotyping-breeding platform in Asia.
- Services including
 - Research cooperation
 - Government research projects
 - Independent research & development
 - Other services & exhibitions

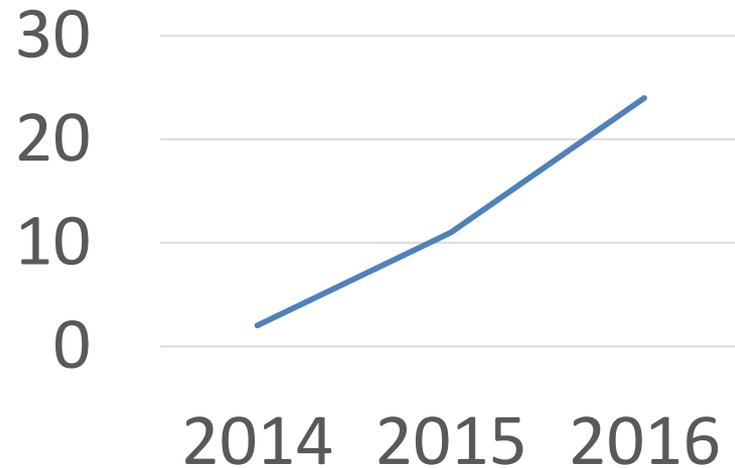


Research Services at AgriPheno™

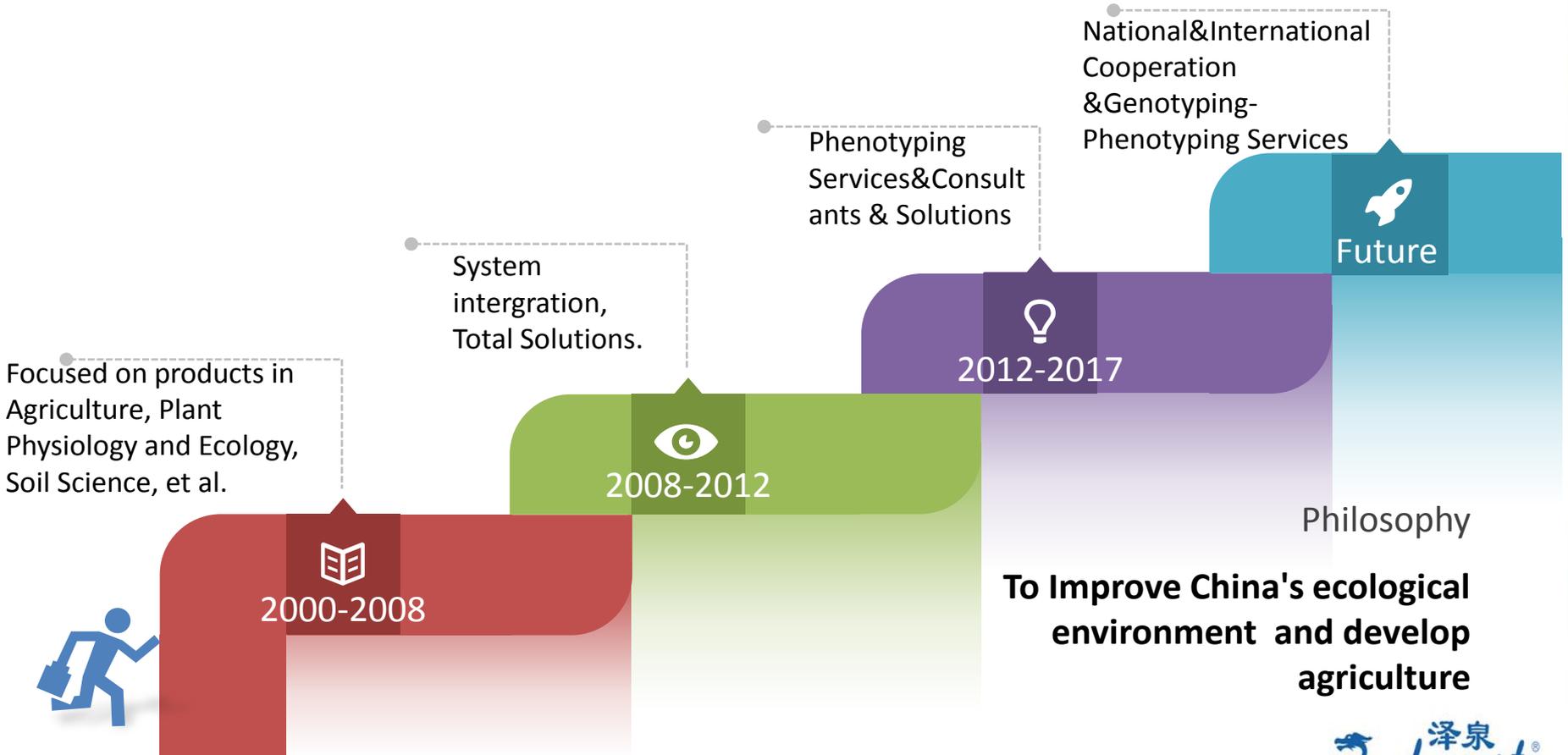
Projects in 2016



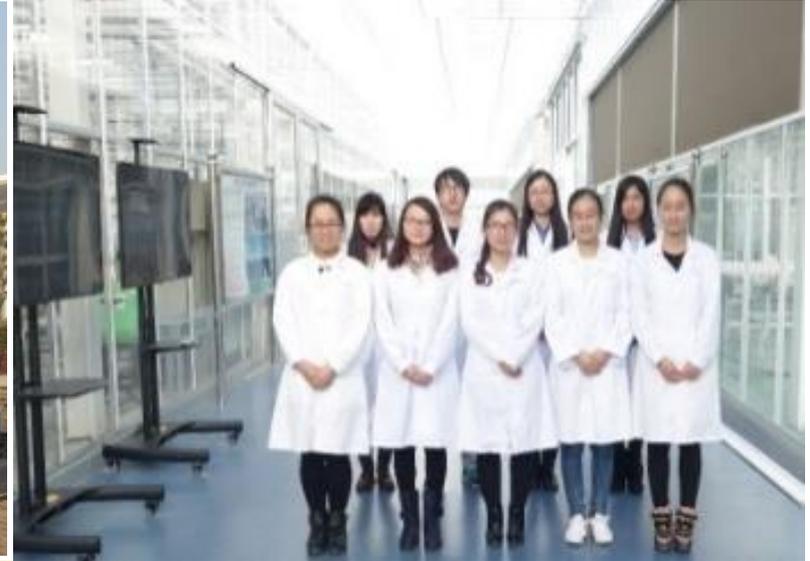
- Free projects
- Independent projects
- Revenue projects



Company development history



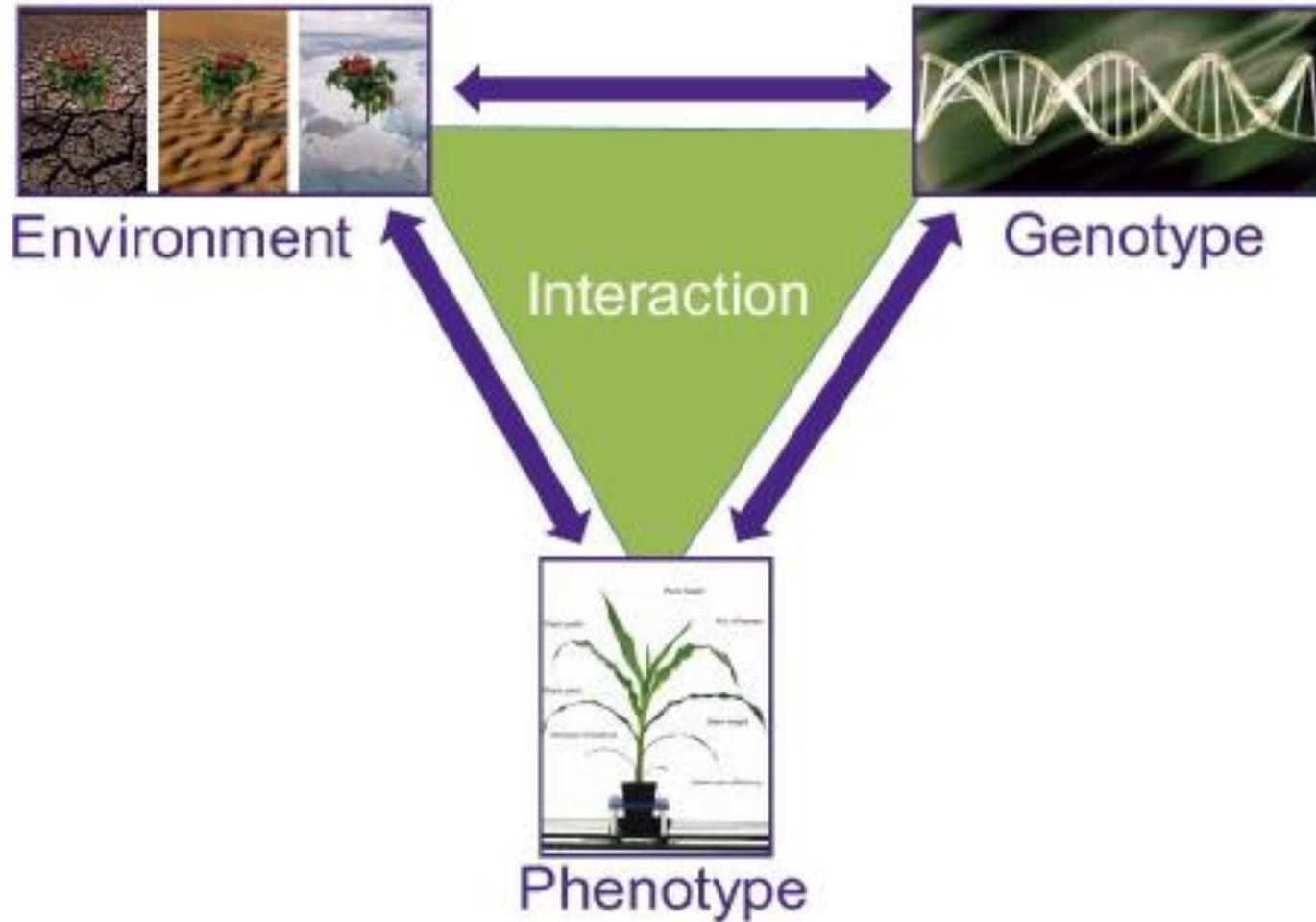
About Us



A wide range of products



植物表型测量的挑战



国际上的植物表型平台

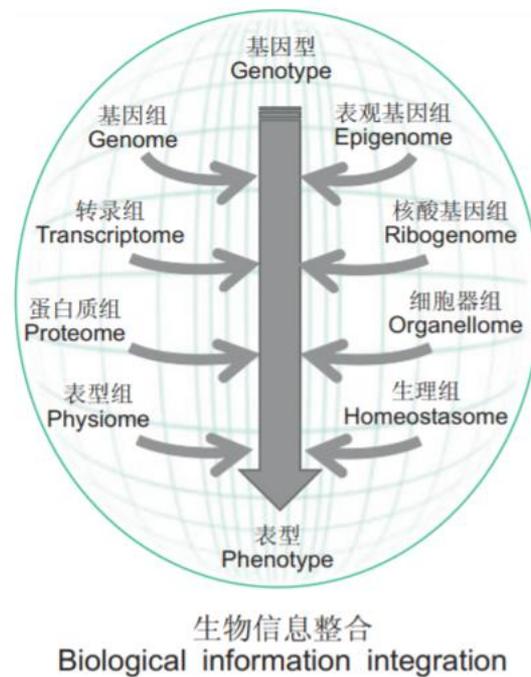
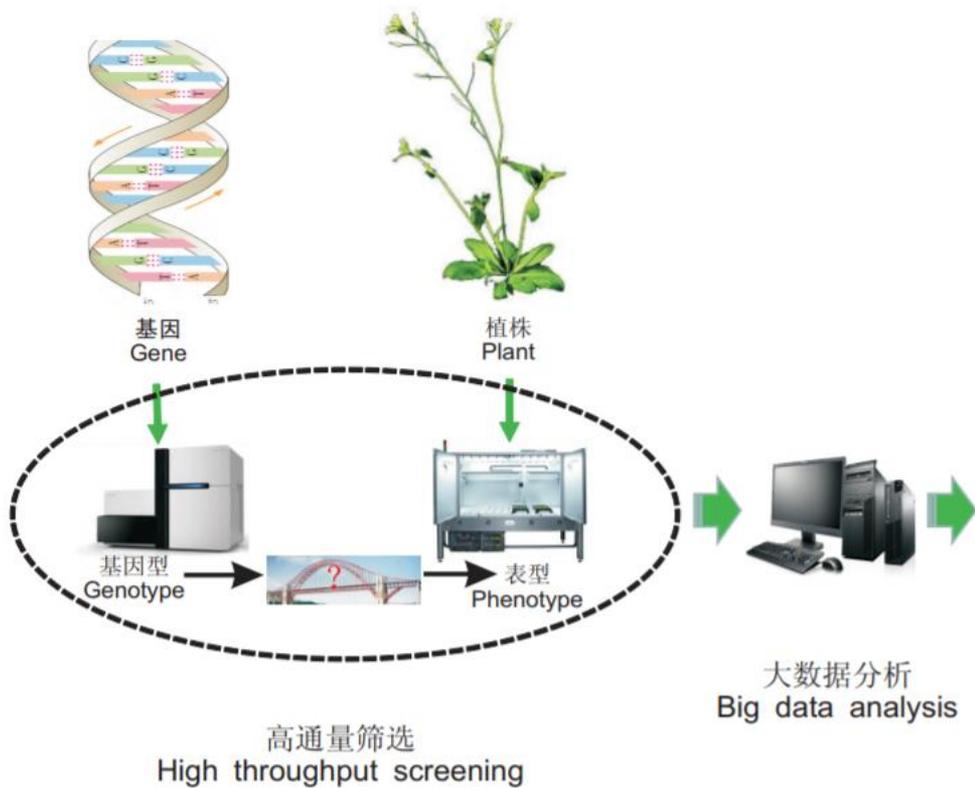
私有的平台

- 产业界：巴斯夫、拜耳作物、先正达、陶氏、日本烟草、英国烟草等。
- 科研界：法国农科院、德国IPK、波恩大学、德国巴伐利亚农业中心、英国Aberystwyth大学、意大利Metaponto研究所、加拿大McGill大学、日本理化学研究院、印度农业委员会、英国洛桑研究所（田间高通量）、美国Maricopa大学（田间高通量）等。

公共服务平台

- 澳洲：Plant Accelerator（2010年）
- 欧洲：PhenoFab（2011年）
Lfl（2013年）
- 美国：DDC（2013年）
- 亚洲：AgriPheno™（2015年）
国内代表客户
- 中国科学院遗传与发育生物学研究所
- 中国科学院逆境生物学研究中心
- 中国农业科学院生物技术研究所
- 北大荒垦丰种业



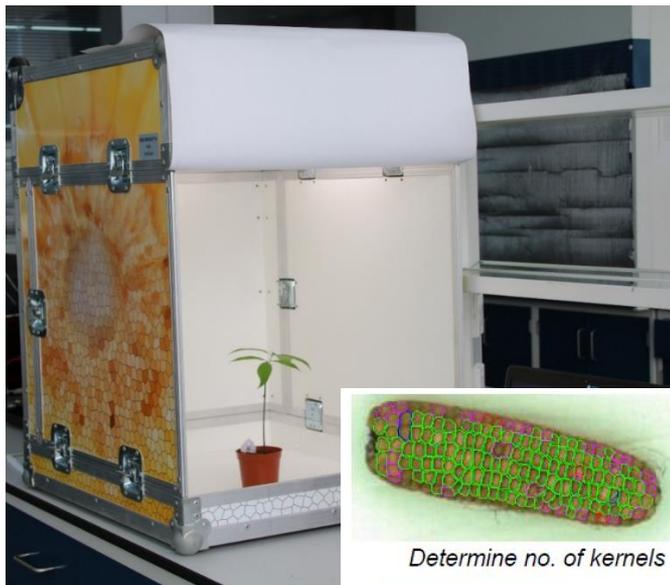


实验室型及便携表型平台

							
	Lab scanalyzer LS30	Phenocenter	Germination scanalyzer	Phenobox	Keybox	Lab scanalyzer LS10	HyperBot



便携式表型测量系统—Keybox



可测量的参数：种子、花卉、果实相关的参数



Determine no. of kernels



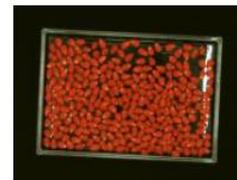
Germination algorithm for dicots



Roundness of a melon



Stem thickness of cabbage



Coverage of seed coating

台式表型测量系统—Lab scanalyzer LS10

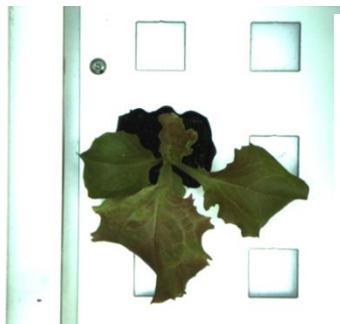


- 可选VIS、NIR、IR或荧光成像中的一种
- 样品最大可达25 cm x 30 cm
- 最大样品高度25 cm
- 多孔板最多可到96孔
- 需手工更换样品

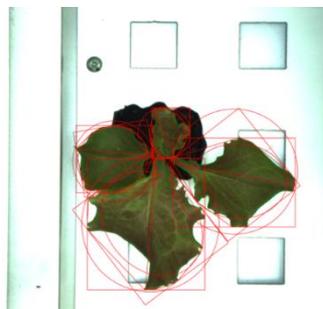


可通过可见光成像对植物等小型样品进行测量，分析植物的结构、宽度、密度、对称性、叶长、叶宽、叶面积、叶颜色、叶病斑、种子颜色、种子颜色面积等外在表型特征参数。

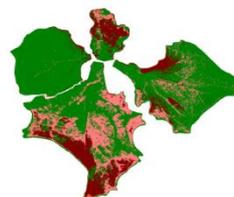
Lab scanalyzer LS10
应用案例



品种12：原图

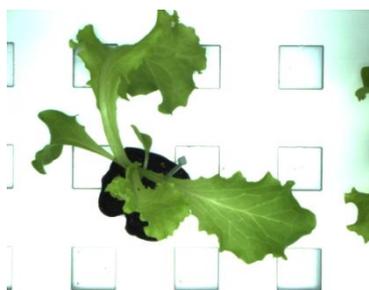


分析1



分析2

投影面积
周长
紧密度
最小外界多边形
面积
偏心率
颜色分级



品种6：原图



分析1



分析2

PhenoBox

- 通过可见光成像，获取果实和种子等植物材料的图像；
- 果实、种子和其它植物材料形状和颜色分析；
- 开源软件，可增加不同植物材料分析算法；
- 自动生成表型参数，可以通过CSV文件导出；
- 触屏电脑，操作简单，中文、英语和德语操作界面；
- 自动生成检测报告，对检测结果进行方差分析等常规统计；
- 仪器坚固可靠，易于搬动



苹果形状与颜色分析流程

Experiment type: Apple shape and color, Apple description..., Camera check, Count seeds, Take Pictures

Experiment series: fruit

Sample ID: granny smith

Analysis results table:

ID	Description	Capture time	Area	Circumference	Roundness	Green
1	fruit	10/27/2016 8:52:11 AM	540646	2851.525	13.03978	0.00220
2	fruit	10/27/2016 8:52:11 AM	436929	2408.395	14.23709	0.00267
3	fruit	10/27/2016 9:27:28 AM	525962	3033.557	17.17392	0.00316
4	fruit	10/27/2016 9:27:28 AM	576214	2884.961	14.38929	0.00319
5	fruit	10/27/2016 9:45:51 AM	588973	3056.826	21.48136	0.00527
6	fruit	10/27/2016 9:45:51 AM	588977	2857.386	14.369	0.00304
7	fruit	10/27/2016 10:05:51 AM	588984	1965.841	23.58844	0.00496
8	fruit	10/27/2016 10:05:51 AM	588914	2854.437	14.32289	0.00303
9	fruit	10/27/2016 11:53:51 AM	539893	2718.695	14.26206	0.00318
10	fruit	10/27/2016 11:53:51 AM	541353	2411.542	14.06918	0.00379
11	fruit	10/27/2016 11:53:51 AM	544793	2884.295	14.85024	0.00382

图像获取

Experiment type: Apple shape and color, Apple description..., Camera check, Count seeds, Take Pictures

Experiment series: fruit

Sample ID: granny smith

Analysis results table:

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颜色分布

Experiment type: Apple shape and color, Apple description..., Camera check, Count seeds, Take Pictures

Experiment series: fruit

Sample ID: granny smith

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数据输出 (csv)

Result file: C:\Users\PhenoBox\Desktop\PhenoBox\fruit\report1.pdf

PhenoBox: apple color and shape analysis

Number of samples:

ID	Class
1	Green
2	Yellow
3	Red
4	Green
5	Yellow
6	Red
7	Green
8	Yellow
9	Red
10	Green
11	Yellow
12	Red

Color class analysis

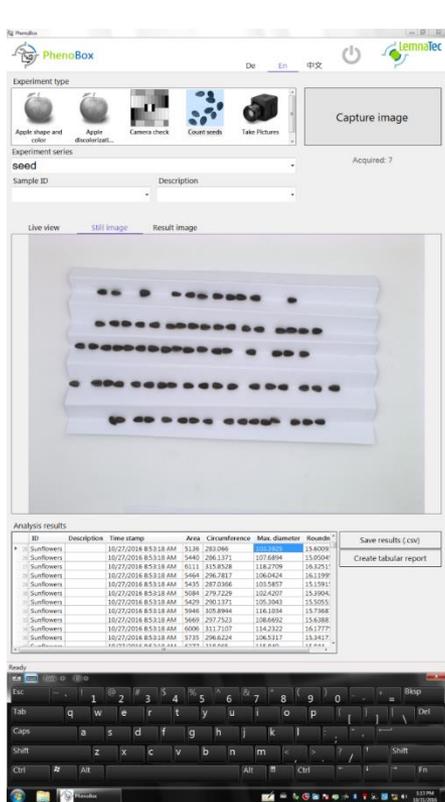
Apple fruit colors are classified according to their color being similar to green, yellow or red. The relative percentage of these color classes are plotted in the following diagrams.

Box plots showing the distribution of color classes for three samples: 10/granny smith, 11/granny smith, and 12/granny smith.

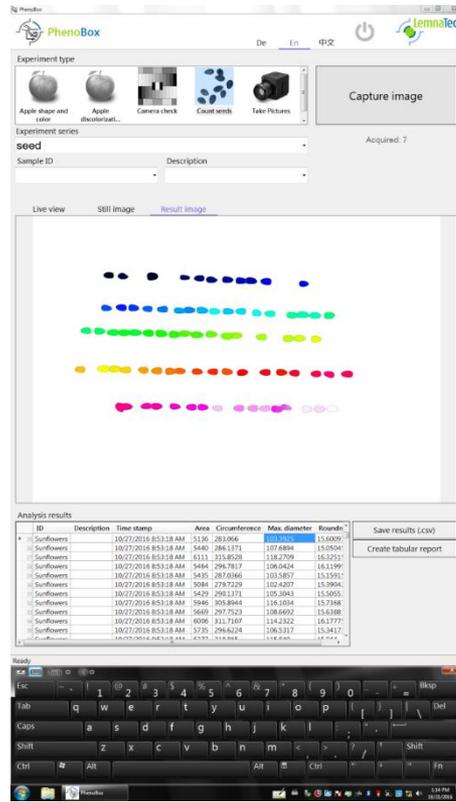
报告



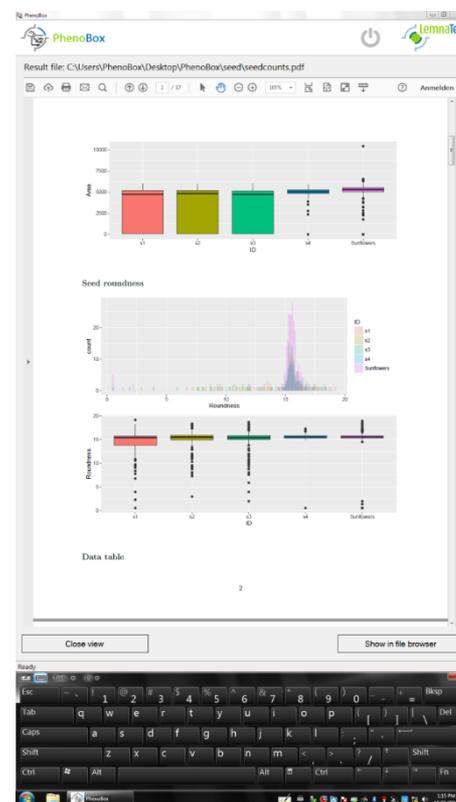
种子大小&形状 图像获取



种子 图像分析



种子 分析报告



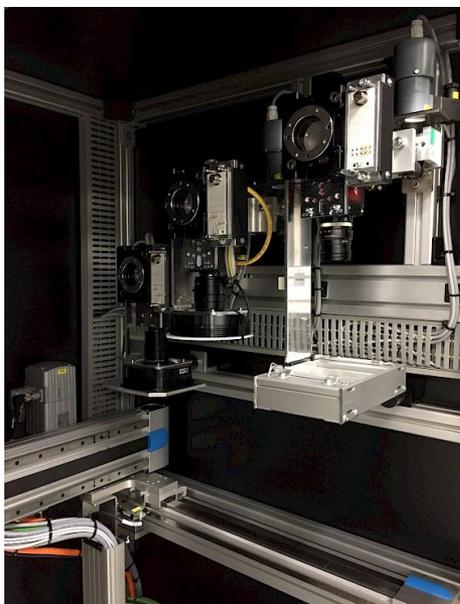
实验室高通量植物表型系统——Lab scanalyzer LS30



- ◆ 可选VIS、NIR、IR、荧光成像或激光3D成像中的一种或多种
- ◆ 高通量测量大量样品，可选4、21、42、63、84个多孔板或穴盘的版本
- ◆ 兼容较大样品
- ◆ 可选择分辨率，适用于96孔板测量
- ◆ 进行动物/昆虫的游动/运动测试时，可自动获取图像

PhenoCenter

- 灵活的扩展区，包括植物培养架
- 灵活的成像设备，可以手动加载（RGB镜头、近红外镜头、荧光镜头、激光高度剖析扫描）



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Fig. 1 The imaging chamber. The robotic arm with the camera and barcode reader over a QuickPot 54R tray is shown. When the chamber is closed, the light is evenly distributed to provide optimal imaging conditions. The light spectrum and intensity are similar to those in the growth chamber.

where 2 mm is used as the threshold to detect new leaves (see earlier).

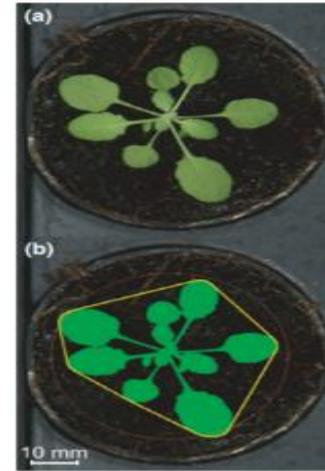
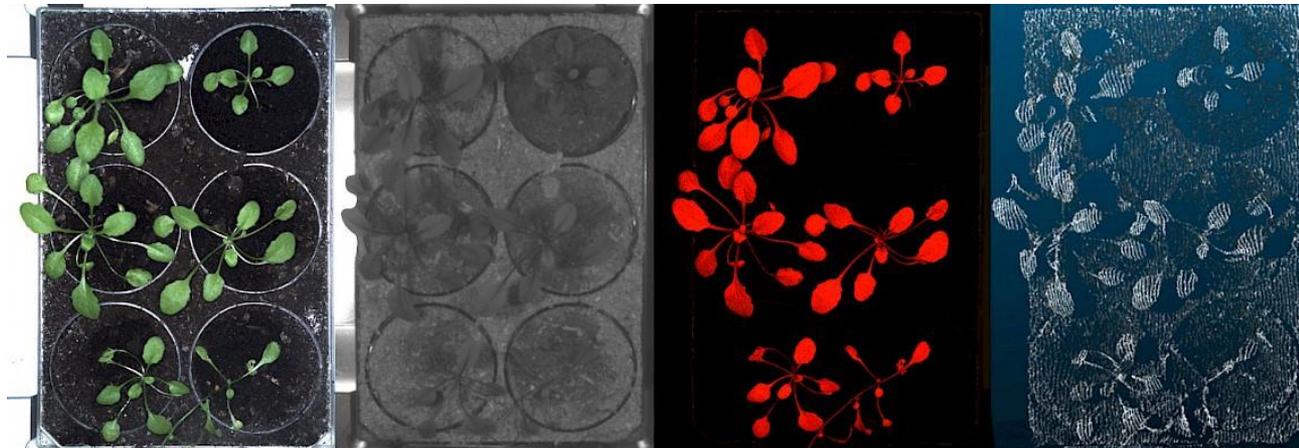


Fig. 2 Example of a plant image before and after processing. Plant image before (a) and after (b) analysis using the LemnaGrid software delivered with the system. In (b) the green area is the detected leaf area and the yellow line outlines the convex hull; the compactness is the total leaf area divided by the convex hull area. The red circle defines the region where the image analysis algorithm expects to find the majority of the plant surface. Outside of this area only green surfaces connected to internal surfaces are included, to avoid inclusion of small patches of moss or algae.

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New Phytologist (2011) **191**: 895–907
www.newphytologist.com

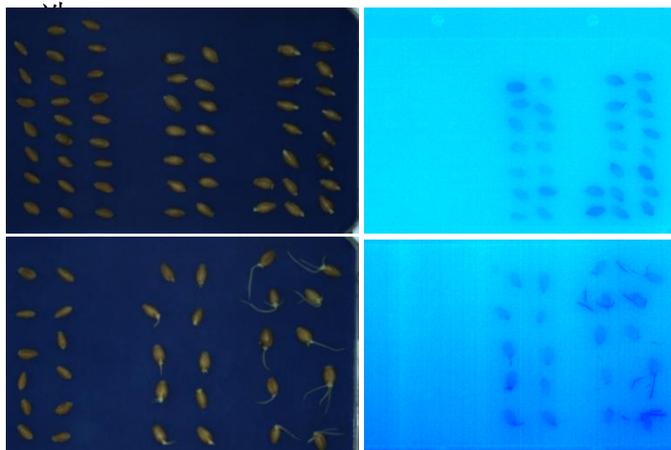


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种子相关指标测定实验

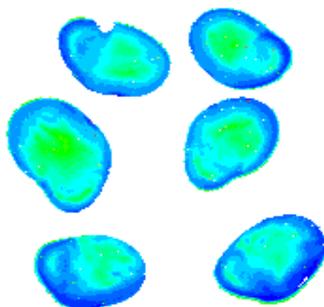
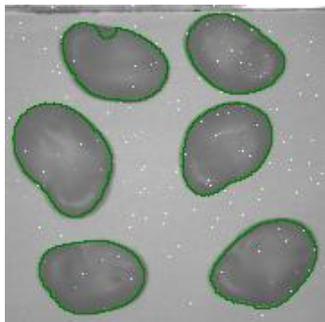


- 种子纯度: HTS可见光成像后, 利用分析软件基于种子形态、大小筛

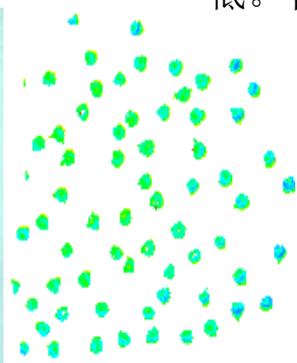
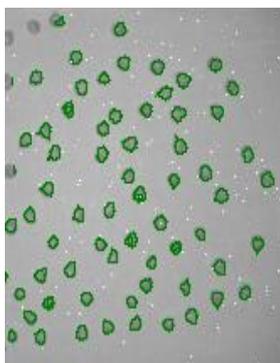


- 种子萌发过程温度变化测定

种子相关指标测定实验



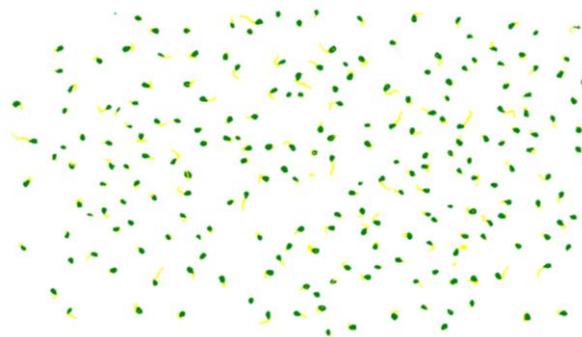
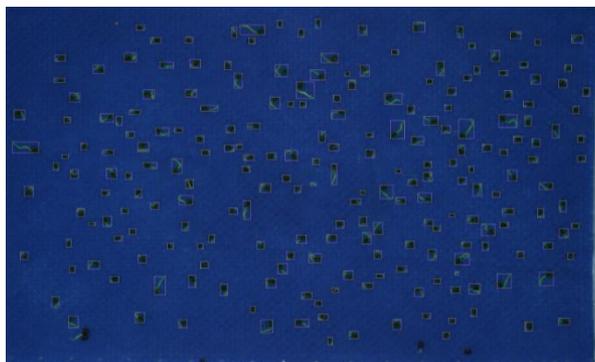
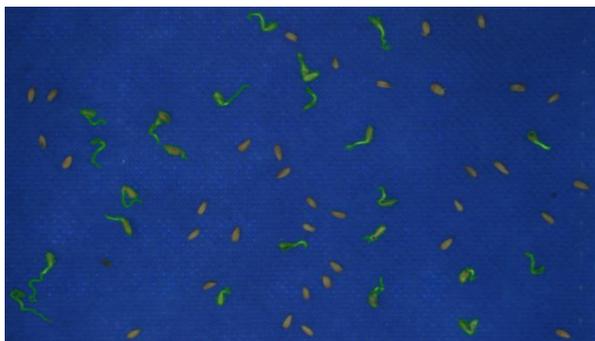
- **种子水分分布**：种子含水量分布（相对值）由近红外成像，分析软件对灰度值进行分析。灰度值高，含水量高；灰度值低，含水量低。



种子相关指标测定实验

- 种子发芽率

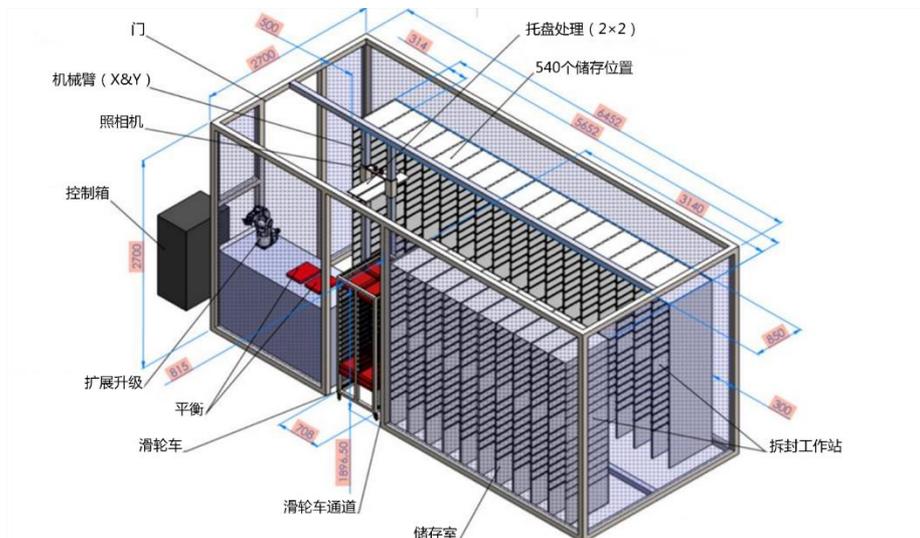
1. 基于种子出芽后形态与出芽前形态变化进行筛选。（参数：紧密度、边界点圆度）



2. 基于种子出芽后芽的颜色与种子颜色不同进行筛选。

种子发芽检测系统— Germination scanalyzer

- ✓ 种子发芽率 (%)
- ✓ 种子发芽速率 (时间)
- ✓ 种子形态学指标 (大小, 圆度)
- ✓ 种子颜色及色泽分布
- ✓ 幼苗形态参数 (根长, 胚轴长度)
- ✓ 幼苗颜色及色泽分布



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机器人激光雷达-高光谱装置



激光雷达模块

- 高精度的3D激光扫描系统（三维上精度均为0.25mm）
- 可以构建3D点阵云图的同时，计算植物的生物量、植物结构等参数

高光谱模块

- 380nm至1000nm的光谱带
- 可以分析的参数包括叶黄素、叶绿素等色素的反射峰值、叶片组织构造如海绵组织的反射率、叶片生化组分、主要植被指数（NDVI、RVI、GVI等）

机器人装置

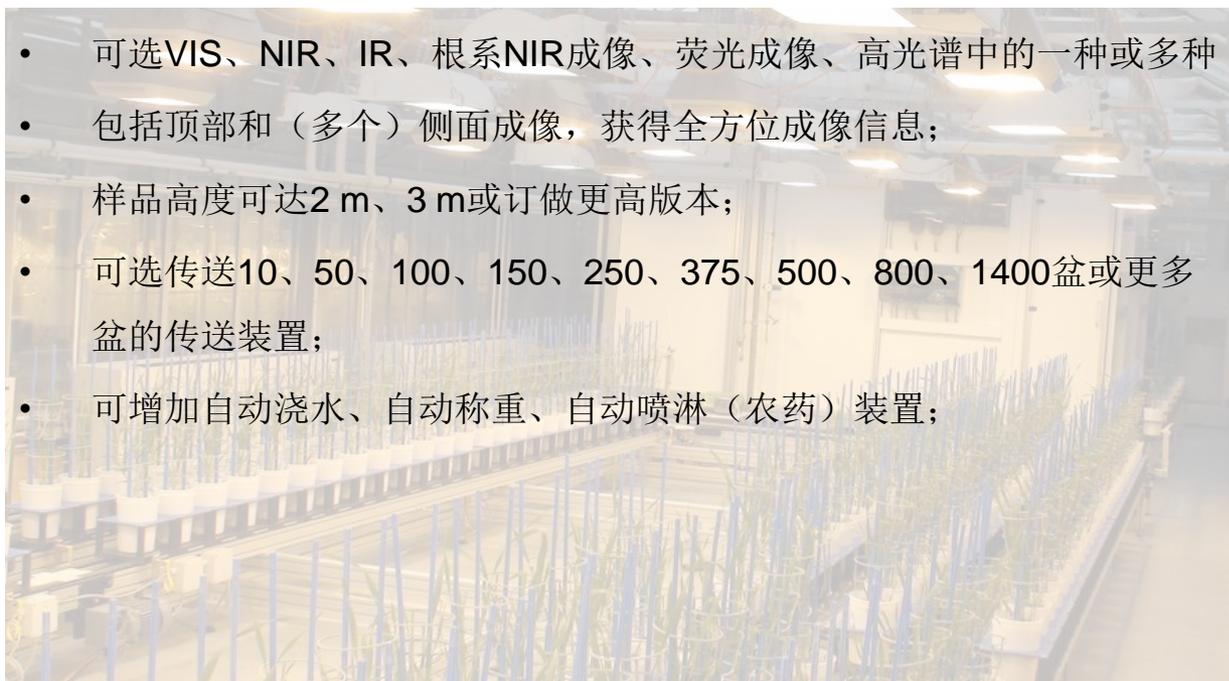
温室型高通量植物表型系统—Greenhouse scanalyzer systems



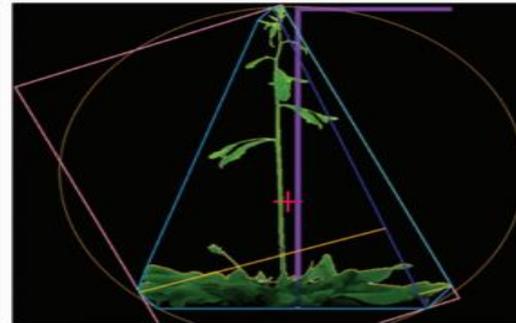
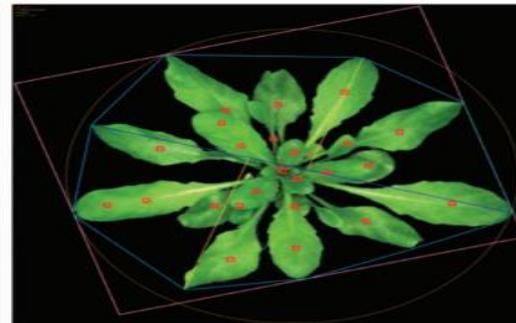
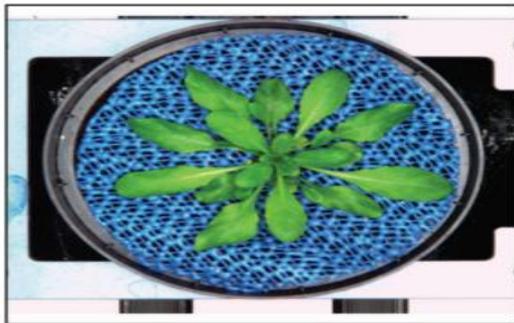
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温室型高通量植物表型系统—Greenhouse scanalyzer systems



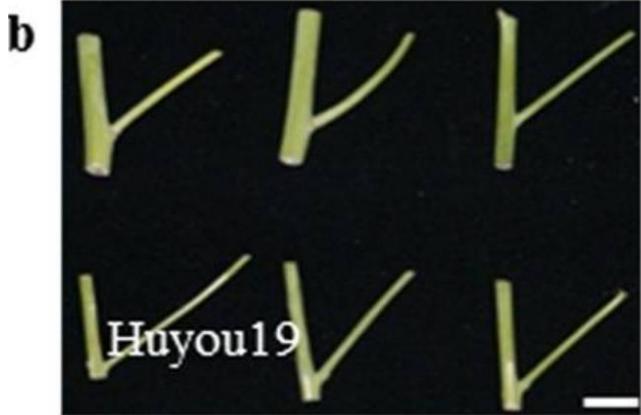
- 可选VIS、NIR、IR、根系NIR成像、荧光成像、高光谱中的一种或多种
- 包括顶部和（多个）侧面成像，获得全方位成像信息；
- 样品高度可达2 m、3 m或订做更高版本；
- 可选传送10、50、100、150、250、375、500、800、1400盆或更多盆的传送装置；
- 可增加自动浇水、自动称重、自动喷淋（农药）装置；



Block name	Description
Acquisition	
Load Images	Load different camera images from local hard drive or database
Pre-processing	
Color Balancing Via	Apply vertical color balancing on VIS image
Background Correction Fluor	Apply vertical color balancing on FLUO image
Background Correction Nir	Removes shading from NIR image
Rotate Images	Correct rotation
Align Images	Align position and scale of different camera images
Detect Blur Markers	Calculate factor for scale conversions (pixel → millimetres)
Clear Mask Wall Processing	Crop round mask
Segmentation	
Adaptive Via Segmentation (KMeans)	K-means based segmentation on VIS image
Adaptive Segmentation Fluor	Create intensity images for red and yellow reflectance
Median Filter	Apply median filter
Remove Small Noise Objects	Remove artefacts on VIS and FLUO image
Adaptive Threshold Nir	Apply adaptive threshold on NIR image
Apply Fluor Mask to Other	Use mask from FLUO image to clear other images (VIS, NIR)
Feature Extraction	
Skeletonize Via Fluor	Calculate the skeleton by thinning on VIS and FLUO image
Skeletonize Nir	Calculate the skeleton by thinning on NIR image
Calculate Width And Height	Determine plant height and width
Calculate Center of Gravity	Calculate centre of gravity
Calculate Area	Calculate plant area (projected area)
Calculate Volume Estimation	Estimate plant volume
Calculate Color- and Intensity- Histograms	Calculate overall color properties (intensity calculation, plant color indices, histogram calculations)
Calculate Convex Hull	Calculate convex hull based shape parameters
Detect Leaf Center Points	Estimation of leaf centres by using a distance map approach
Post-processing	
Run Post Processors	Draw analysis results of feature extraction blocks
Move Mask Set to Image Set	Transfer images to result image set
Crop Result Images	Crop result images
Highlight Wall Results	Mark centers and outlines in result image set

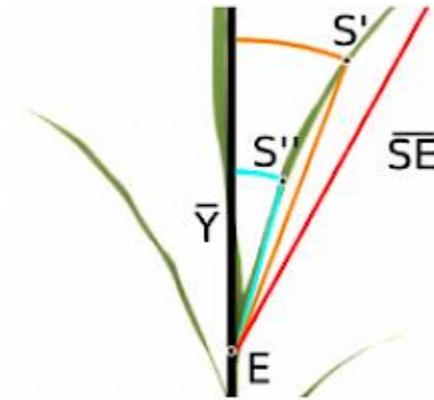
Daniel Arend *et al.*, SCIENTIFIC DATA | 3:160055 |
DOI: 10.1038/sdata.2016.55





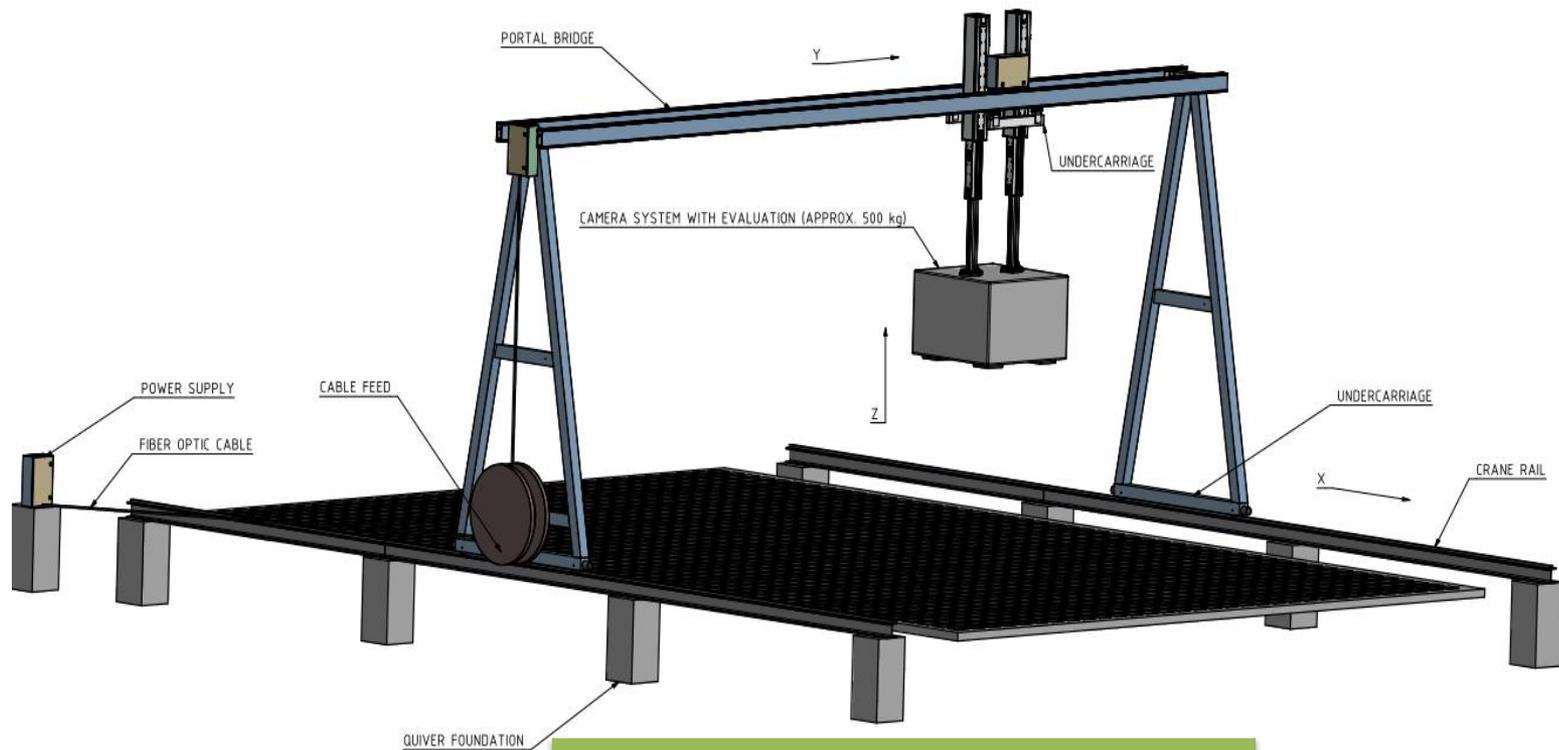
branch angle

Branch angle as a plant architecture component trait plays an important role for high density planting and yield performance.



田间表型系统——field scanalyzer





宽度	成像面积宽度在10m面积范围
长度	100m面积范围
X轴精确度	±50mm (关于铁轨)
Y轴精确度	±5mm (关于Y轴)
Z轴精确度	±5mm (关于Z轴)
X轴运行速度	最大60m/min
Y轴运行速度	最大20m/min
Z轴运行速度	最大5m/min



田间表型系统——field scanalyzer 主要配置

可选传感器

可见光镜头
叶绿素荧光镜头
近红外镜头
高光谱镜头
激光3D

经典参数

冠层高度
叶片结构
生物量
植被指数
水分含量
光合效率
空气温度
风速
空气湿度

控制器

专用电脑以及数据服务器

软件

程序控制、图像处理、数据分析



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广泛适合各种农作物：油菜、小麦、
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田间可移动式表型系统



X-光根系系统

- ✓ Plant Developmental Stage
- ✓ Plant Height
- ✓ Stalk Diameter
- ✓ Leaf Area
- ✓ Chlorophyll Content

- ✓ Projected Root Area
- ✓ Total Root Length
- ✓ Total Root - Transect Crossings
- ✓ Root Distribution by Depth



- ✓ Total Dry Weight Biomass
- ✓ Shoot Dry Weight Biomass
- ✓ Root Dry Weight Biomass
- ✓ Root/Shoot Dry Weight Biomass Ratio

The Power of the Whole Picture



已经发表论文的情况

Literature_LemnaTec [兼容模式] - Excel(产品激活失败)

文件 开始 插入 页面布局 公式 数据 审阅 视图

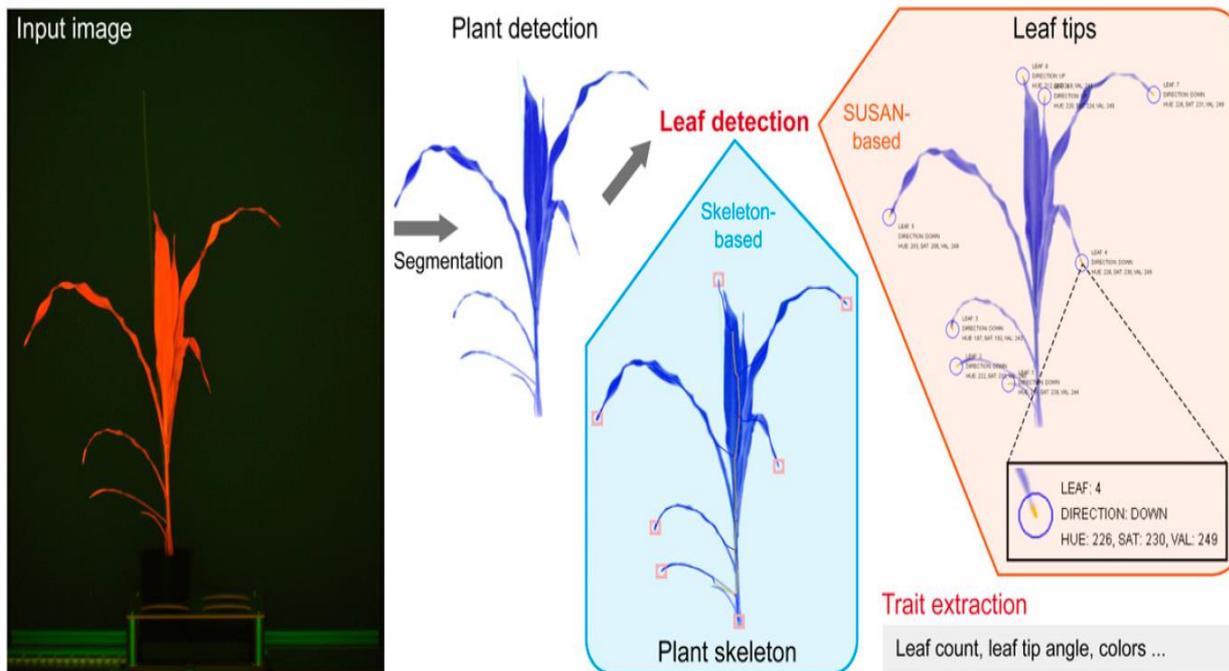
剪贴板 字体 对齐方式 数字 样式 单元格 编辑

Q21

	A	B	C	D	E	F	G	H	I	J	K
1	Author	Year	Title	Journal	Volume	Number	pages	DOI	Online-Address		
2	An, Nan; Palmer, Christine M.; Baker, Robert	2016	Plant high-throughput phenotyping using photogram	Computers and Electron	127		376-394	10.1016/j.com	https://scholar.google.com/scholar?cluster=17081		
3	Barabaschi, Delfina; Tondelli, Alessandro; D	2016	Next generation breeding	Plant Science	242		3-13	10.1016/j.pla	http://linkinghub.elsevier.com/retrieve/pii/S016894		
4	Shao, Mon-Ray; Shedge, Vikas; Kundariya, f	2016	Ws-2 Introgression in a Proportion of Arabidopsis thal	Plant Cell (The Plant Cell			tpc.0005	10.1105/tpc.1	http://www.plantcell.org/content/early/2016/03/15		
5	Arend, Daniel; Lange, Matthias; Pape, Jean-f	2016	Quantitative monitoring of Arabidopsis thaliana growth	Scientific Data	3		160055	10.1038/sdat			
6	Ziegler, P.; Sree, K. S.; Appenroth, K.-J.	2016	Duckweeds for water remediation and toxicity testing	Toxicological & Environ			1-28	10.1080/0277			
7	Virlet, Nicolas; Sabermanesh, Kasra; Sadegh	2016	Field Scanalyzer: An automated robotic field phenotypi	Functional Plant Biology				10.1071/FP16			
8	Chelal, John; Hau, Bernhard	2015	Modelling the interaction between powdery mildew epi	European Journal of Pla			1-19	10.1007/s106	http://dx.doi.org/10.1007/s10658-015-0626-7		
9	Liu, Zhe; Zhang, Fan; Ma, Qin; An, Dong; Li,	2015	Advances in crop phenotyping and multi-environment	Frontiers in Agricultural	2	1	28	10.15302/J-F	http://engineering.cae.cn/fase/EN/10.15302/J-FAS		
10	Matos Maruyama, Teruo; Silva Ribeiro, Serg	2015	Estudo Comparativo de Opções de Software de Proces	Anais SULCOMP	7	1			http://periodicos.unesc.net/index.php/sulcomp/art		
11	Rahaman, Md. Matiur; Chen, Dijun; Gillani, Z	2015	Advanced phenotyping and phenotype data analysis fo	Frontiers in Plant Scienc	6			10.3389/fpls.	http://journal.frontiersin.org/article/10.3389/fpls.2		
12	Story, David; Kacira, Murat	2015	Design and implementation of a computer vision-guide	Machine Vision and Ap	26	4	495-506	10.1007/s001	http://link.springer.com/10.1007/s00138-015-067		
13	Vello, Emilio; Tomita, Akiko; Diallo, Amadou	2015	A Comprehensive Approach to Assess Arabidopsis Sur	Frontiers in Plant Scienc	6			10.3389/fpls.			
14	Ganguly, Diep; Crisp, Peter; Harter, Klaus; P	2015	Genetic suppression of plant development and chlorop	Functional Plant Biology							
15	Junker, Astrid; Muraya, Moses M.; Weigelt-f	2015	Optimizing experimental procedures for quantitative ev	Frontiers in Plant Scienc	5			10.3389/fpls.			
16	Muscolo, A.; Junker, A.; Klukas, C.; Weigelt-f	2015	Phenotypic and metabolic responses to drought and se	Journal of Experimental				10.1093/jxb/e	http://jxb.oxfordjournals.org/lookup/doi/10.1093/		
17	Neilson, E. H.; Edwards, A. M.; Blomstedt, C.	2015	Utilization of a high-throughput shoot imaging system	Journal of Experimental				10.1093/jxb/e	http://jxb.oxfordjournals.org/lookup/doi/10.1093/		
18	Parent, Boris; Shahinnia, Fahimeh; Maphosa	2015	Combining field performance with controlled environm	Journal of Experimental				10.1093/jxb/e	http://jxb.oxfordjournals.org/lookup/doi/10.1093/		
19	Takahashi, Fuminori; Tilbrook, Joanne; Tritte	2015	Comparison of Leaf Sheath Transcriptome Profiles with	PLOS ONE	10	8	e0133322	10.1371/journ	http://dx.plos.org/10.1371/journal.pone.0133322		
20	Boyle, Roger; Corke, Fiona; Howarth, Cather	2015	Image-based estimation of oat panicle development us	Functional Plant Biology	42	5	433	10.1071/FP14	http://www.publish.csiro.au/?paper=FP14056		
21	Meepagala, Kumudinim.; Johnson, Robertd	2015	Phomalactone from a Phytopathogenic Fungus Infecti	J Chem Ecol (Journal of			1-11	10.1007/s108			
22	Picado, Ana; Paixão, Susanam.; Moita, Lilian	2015	A multi-integrated approach on toxicity effects of engir	Front. Environ. Sci. Eng.			1-11	10.1007/s117			

就绪

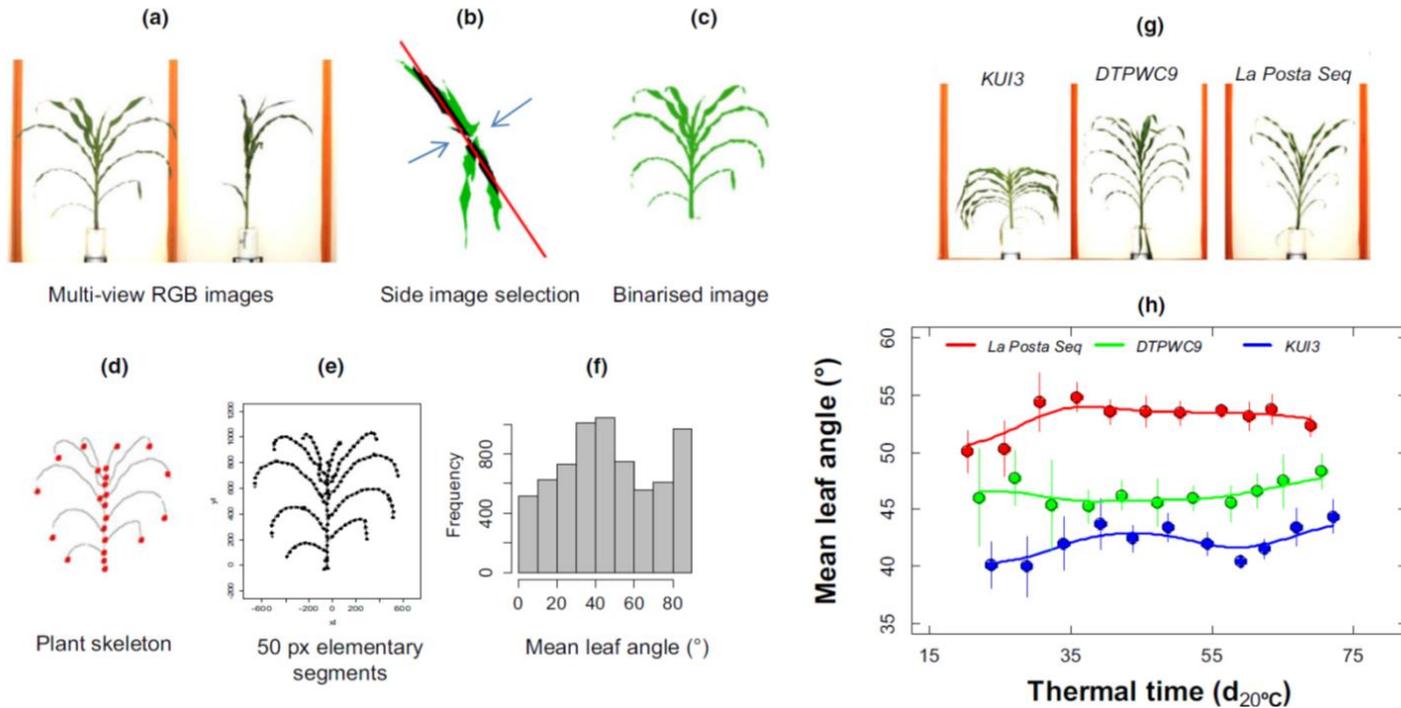




玉米叶片分析

植物结构、叶角度、节间长度、叶长、投影面积、开展度、紧密度、周长、偏心率、圆度、颜色分级、病斑分析、外接多边形面积

不同品种的玉米表型成像系统



通过顶部和侧面的3D成像，分析、提取出不同品种的玉米植株骨架数据，可进一步计算包括叶倾角在内的多种参数。

Lloren, Cabrera-Bosquet *et al.*, New Phytologist(2016)



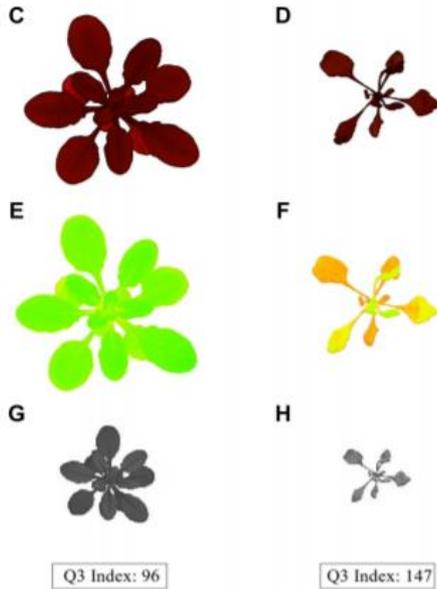
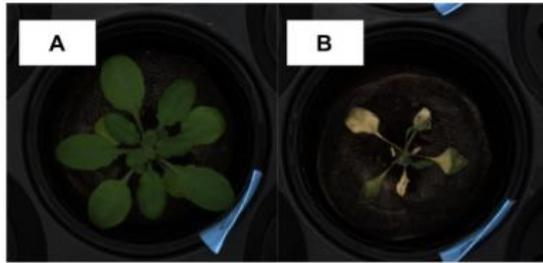


FIGURE 2 | Treatment phenotypes. A sample from each treatment group (**A,C,E,G**) well-watered and (**B,D,F,H**) water-limited (Mutant line *drs1*, "pellet protocol"). Row images from VIS camera (**A,B**). "Digital plants" from FLUO after segmentation process (**C,D**). Color representation of the plants after color classification (**E,F**). NIR "digital plants" with the indexes based on the third quartile (Q_3) of the intensity histogram (**G,H**).

结构、宽度、密度、对称性、叶长、叶宽、叶面积、叶颜色、叶病斑、种子颜色、种子颜色面积

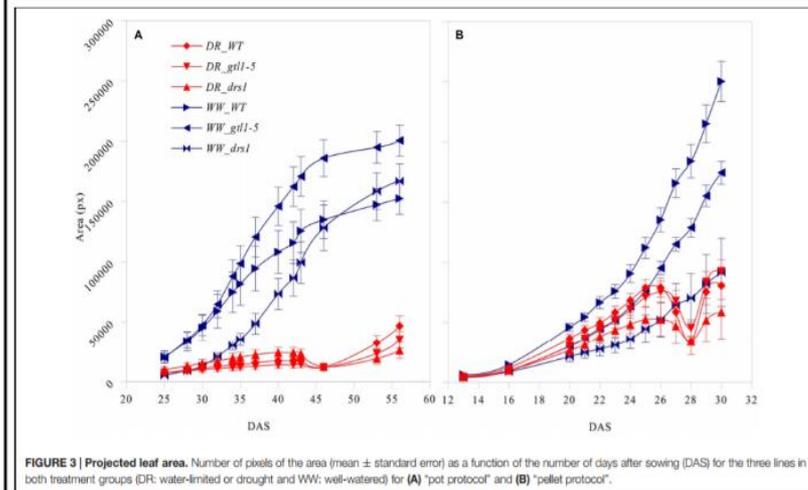
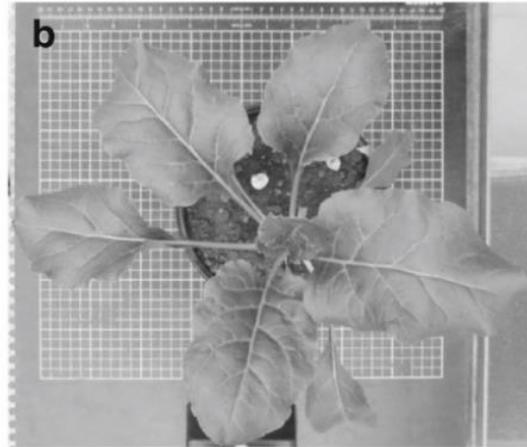


FIGURE 3 | Projected leaf area. Number of pixels of the area (mean \pm standard error) as a function of the number of days after sowing (DAS) for the three lines in both treatment groups (DR: water-limited or drought and WW: well-watered) for (**A**) "pot protocol" and (**B**) "pellet protocol".

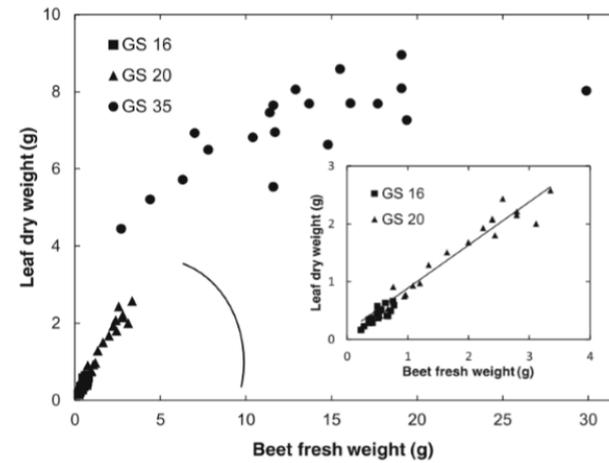
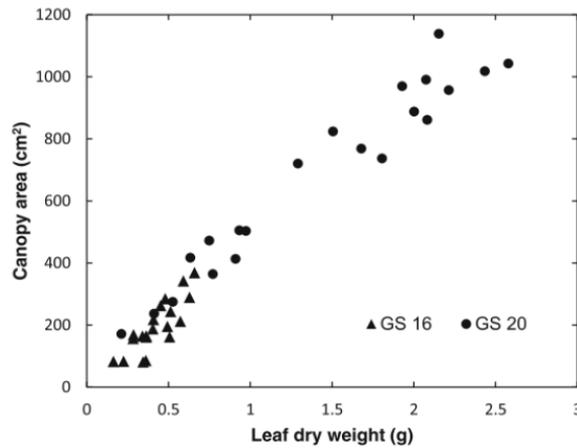
Emilio Vello *et al.*, Frontiers in Plant Science 2015

数字冠层面积与生物量的关系

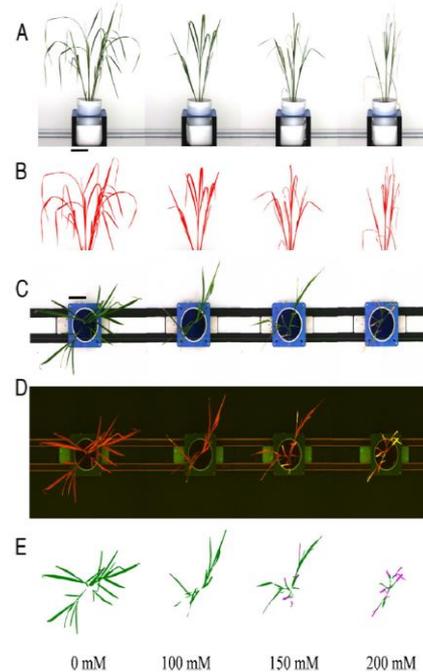
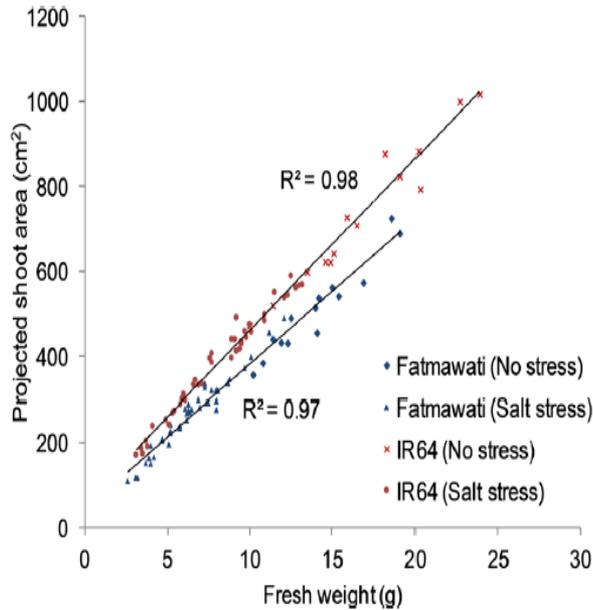


Digital canopy area: 963 cm²

Plant Soil



逆境胁迫下水稻表型分析



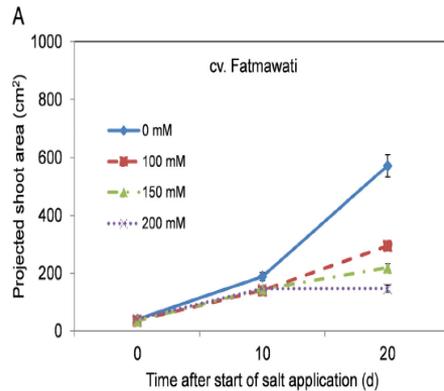
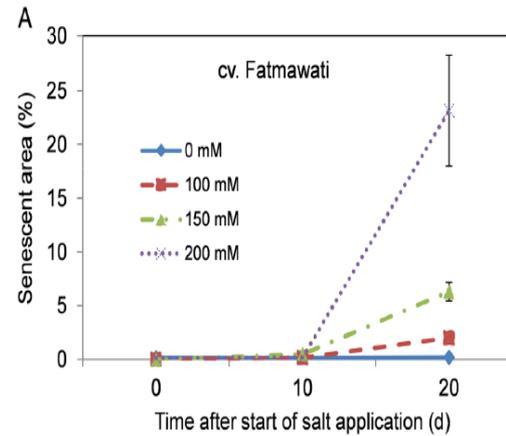
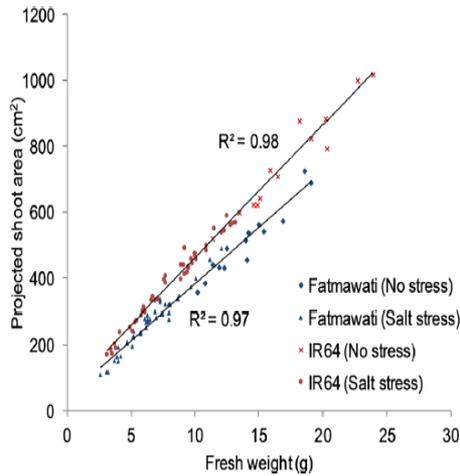
A-C, 水稻
栽培变种
Fatmawati
可见光侧
面和顶部
成像

D-E, 水稻
栽培变种
Fatmawati
荧光成像

不同浓度NaCl处理20天后水稻
的表型

Aris Hairmansis, Stuart John Roy et al., Rice(2014)





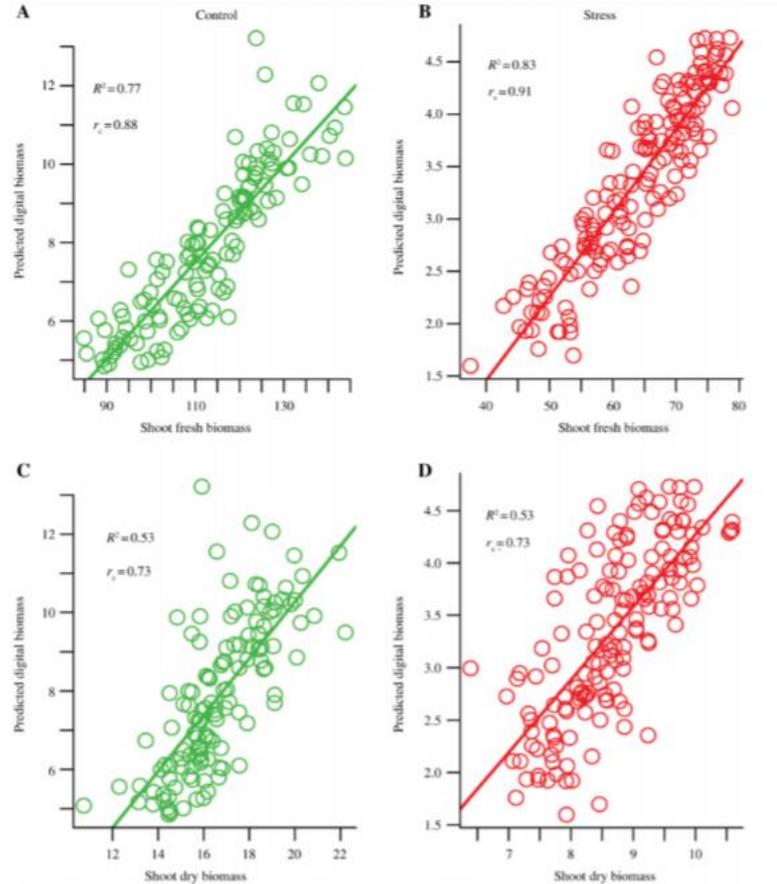
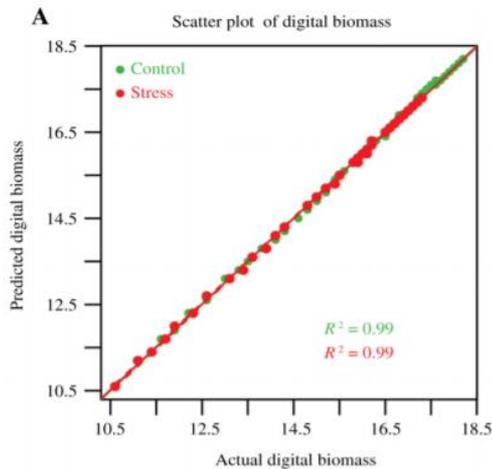
1. 利用3D表型技术，逆境胁迫下重要的参数—生物量的测定可以用植株投影面积表示，进而实现对植物的无损测量。
2. 随着盐分胁迫时间的延长，水稻衰老部分的面积有不同程度的增加。

$$\text{Digital biomass} = \sqrt{\text{average pixel side area}^2 \times \text{top area}}$$

Model 1: $D_b = a_0 + a_1 \times A + a_2 \times PC + e_0$

Model 2: $D_b = a_0 + a_1 \times A + a_2 \times PC \times HD + e_0$

Model 3: $D_b = a_0 + a_1 \times A + a_2 \times A \times HD + a_3 \times PC + e_0$



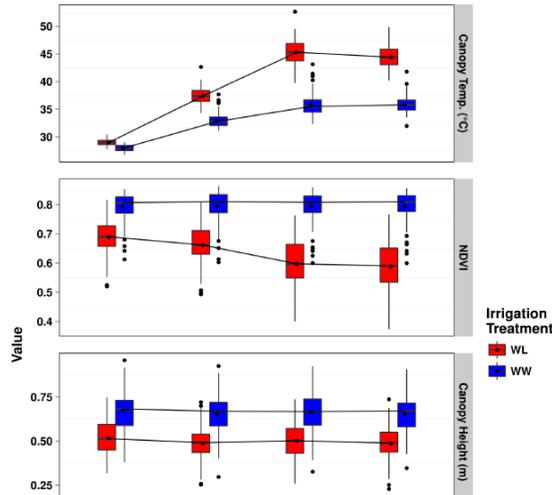
以不同处理的大麦表型数据为基础，进行模型建立和验证，所得模型结果可用来预测生物量。

<http://iapg2p.sourceforge.net/modeling/#dataset>

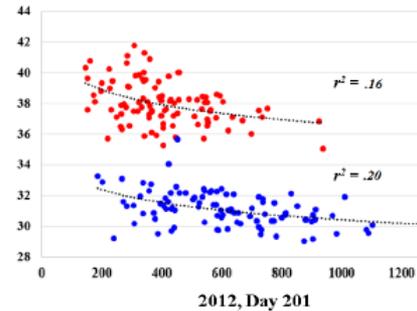
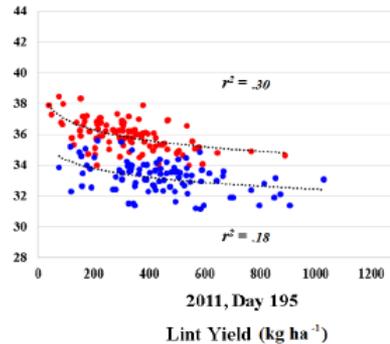
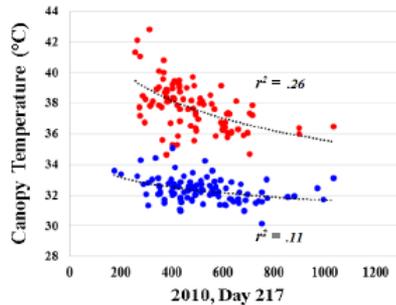
A代表投影面积，HD代表植物年龄、PC代表植物紧密度



不同灌溉条件下棉花的田间表型分析



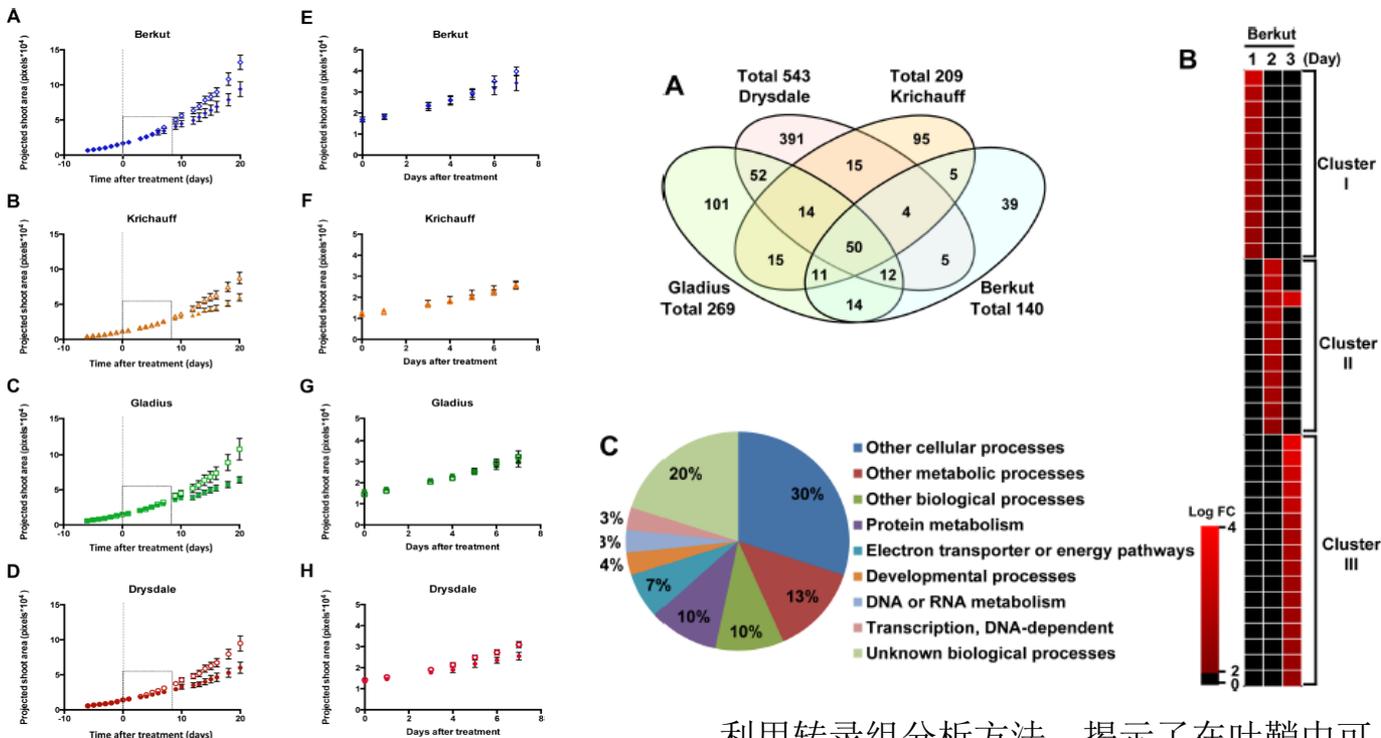
1. 利用高通量田间表型成像，同步测量冠层温度、NDVI、冠层高度和叶面积指数等。
2. 相关性分析，冠层温度与产量之间呈负相关关系。



Duke Pauli, Michael A. Gore et al., G3: Genes/Genomes/Genetics (2016)



小麦表型与基因型分析



盐分胁迫后，不同品种小麦投影面积(A-D)与生长速率(E-H)的动态变化曲线测定。

利用转录组分析方法，揭示了在叶鞘中可能存在的植株生物量与耐盐性相关的基因功能。

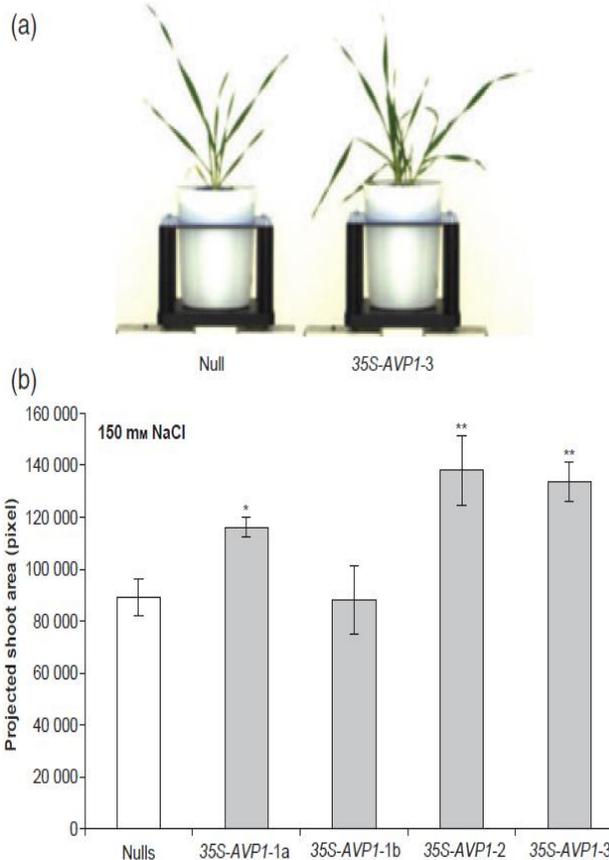
Takahashi, F. et al., PLoS One(2015)

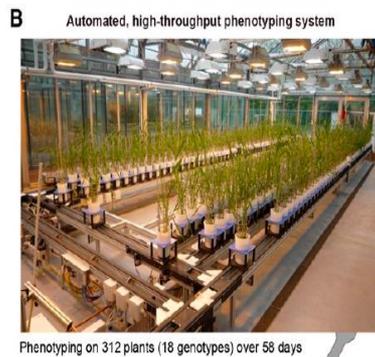
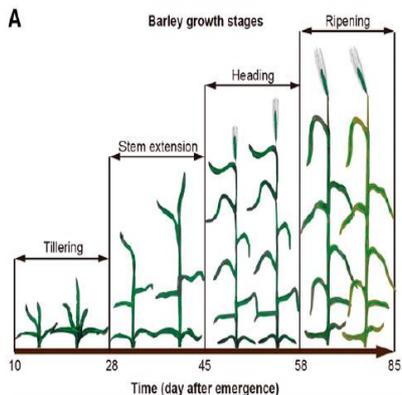


盐分胁迫下转基因大麦的表型分析

可见光3D成像后，计算得出植株的投影面积，整体而言，*AVP1*基因过表达的大麦株系投影面积大于对照的，说明*AVP1*基因可以提高植物的耐盐能力。

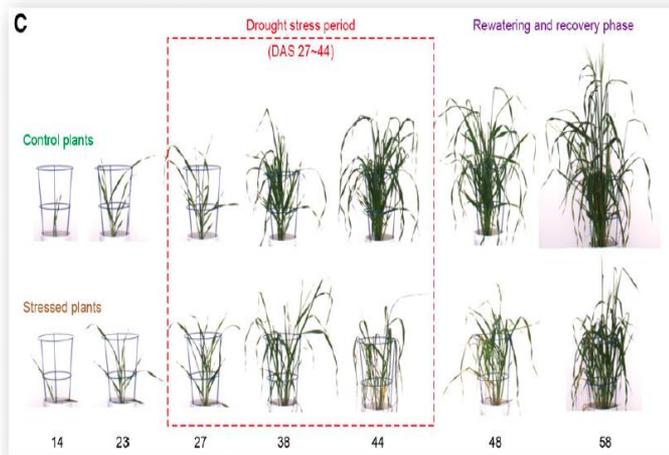
Rhiannon K. Schilling, Darren C. Plett et al., *Plant Biotechnology Journal*(2014)





干旱和复水处理下 大麦的表型分析

1. 植株高度及其动态变化
2. 生物量
3. 有效分蘖数变化



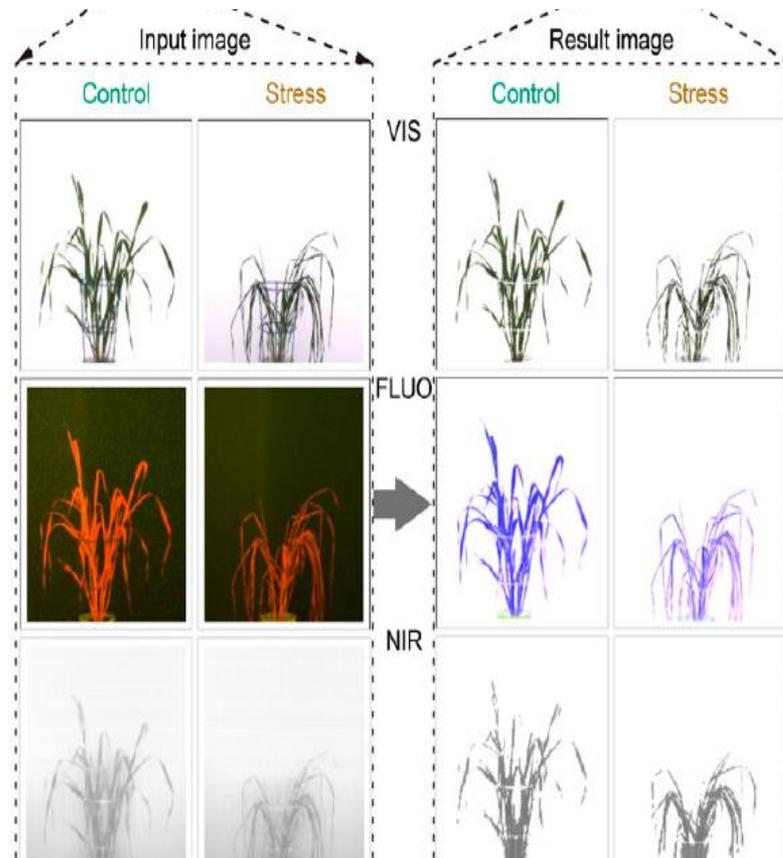
干旱和复水处理下，利用3D系统大麦进行表型分析。

Dijun Chen, Christian Klukasa *et al.*, The Plant Cell(2014)

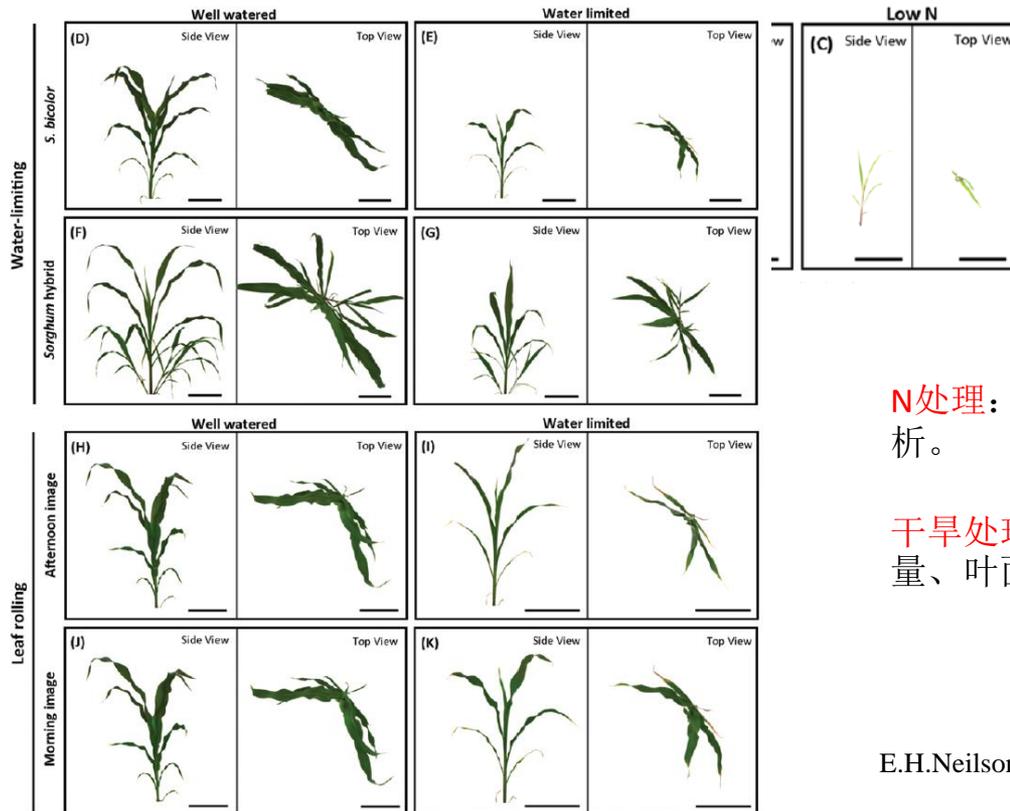


逆境胁迫下大麦的表型分析

1. 植株含水分布情况（近红外成像分析）
2. 植株生理变化（荧光成像分析）



不同浓度N处理以及干旱处理下大麦的表型分析



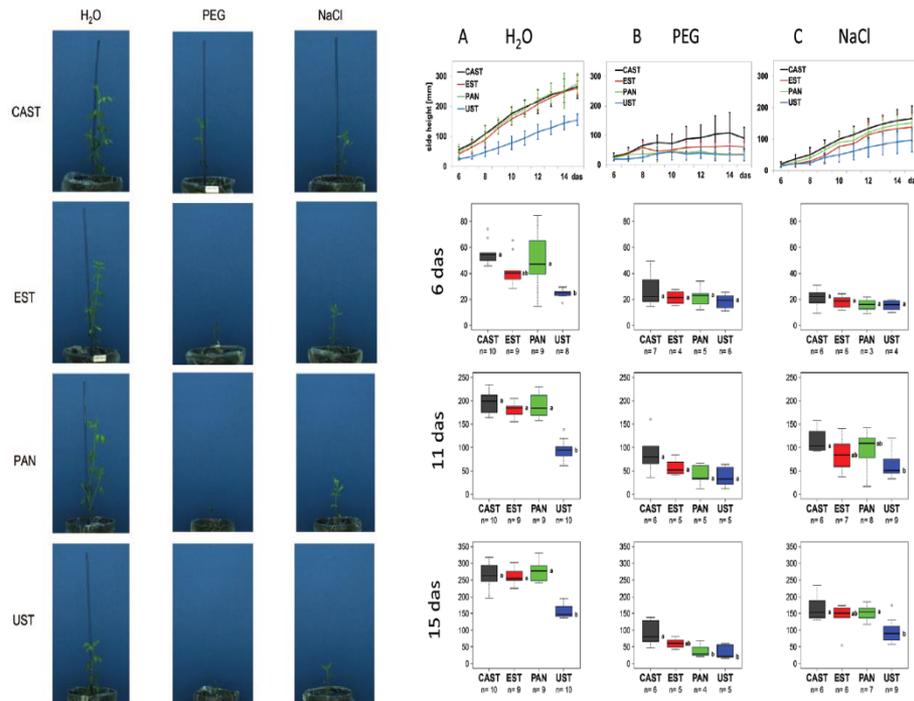
N处理：植株大小、颜色分析。

干旱处理：植株形态、生物量、叶面积、叶卷曲度。

E.H.Neilson,R.M.Gleadow *et al.*,Journal of Experimental Botany(2015)



不同品种扁豆干旱和盐分胁迫下表型分析

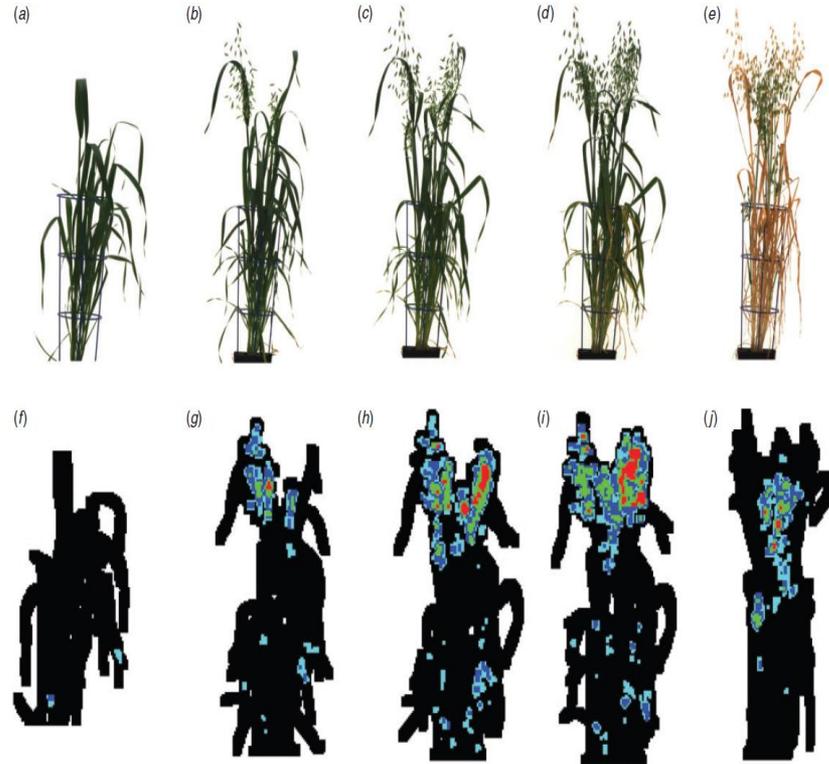


植株高度
及其动态
变化曲线

A. Muscolo, T. Altmann *et al.*, Journal of Experimental Botany(2015)



燕麦穗的发育

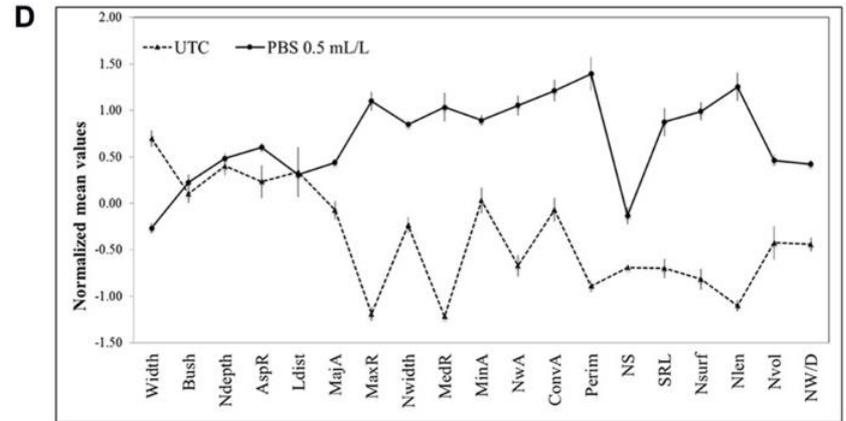
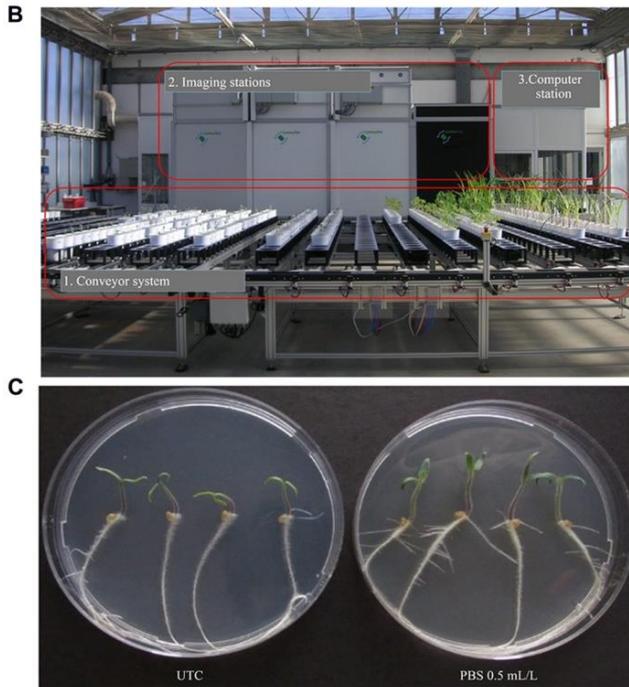


通过穗部检测过滤器，
提取不同时期燕麦的表型特征参数。

Roger Boyle, Catherine Howarth *et al.*, Plant Biology(2015)



表型分析下番茄的筛选

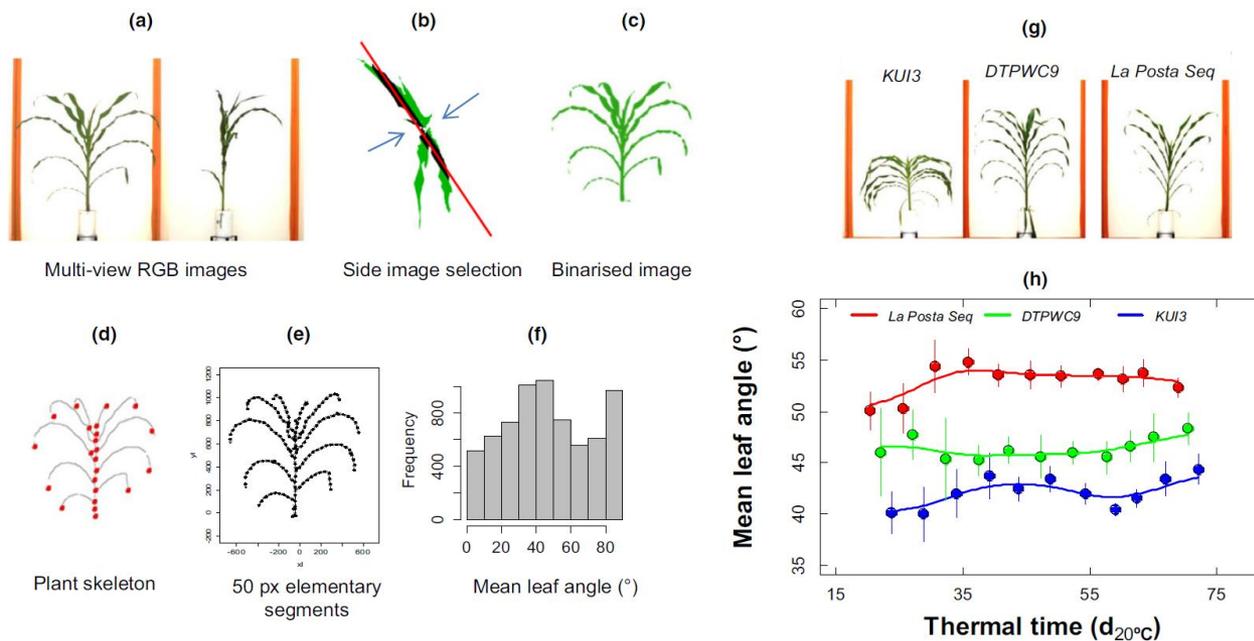


在 LemnaTec-Scanalyzer 3D 系
统下用 RGB, NIR 成像

Giovanni Povero*, Juan F. Mejia, Donata Di Tommaso et al.,
Frontiers in Plant Science(2016)



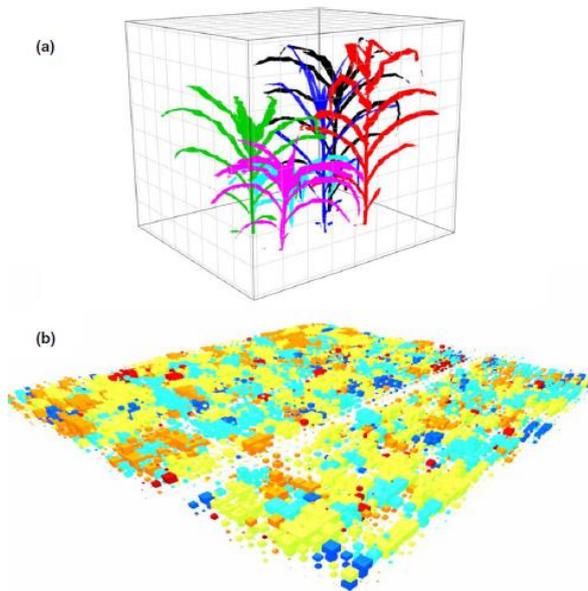
不同品种的玉米表型成像系统



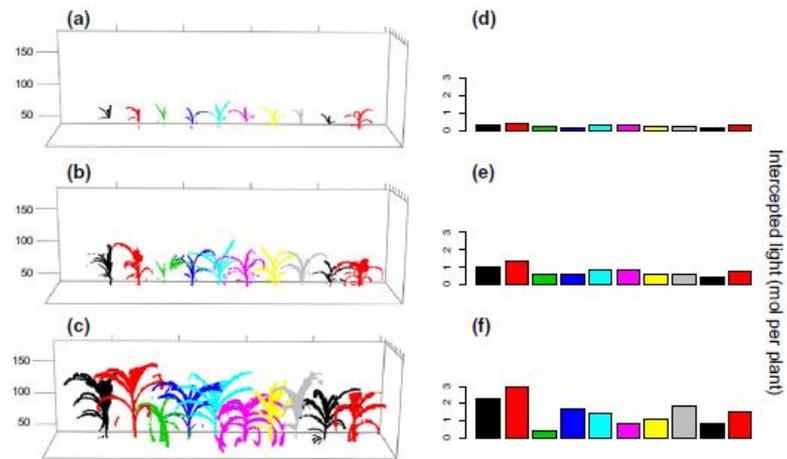
植物骨架
平均叶倾角

Lloren, Cabrera-Bosquet *et al.*, New Phytologist(2016)

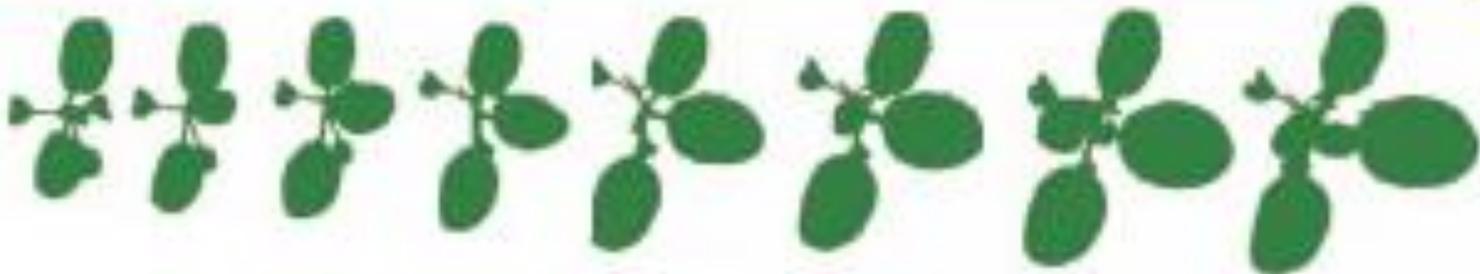




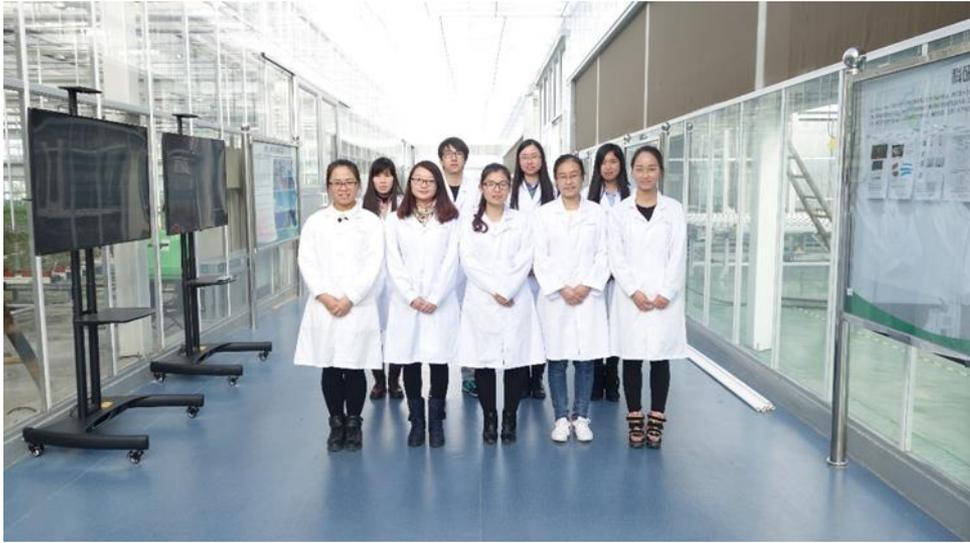
法国INRA以LemnaTec 3D表型设备为基础，进行系统改造与集成，可以完成植物3D模型重建



- AgriPheno™平台基础建设
- AgriPheno™平台科研服务
- AgriPheno™平台项目介绍



AgriPheno™平台建设



CONVIRON植物培养箱建设



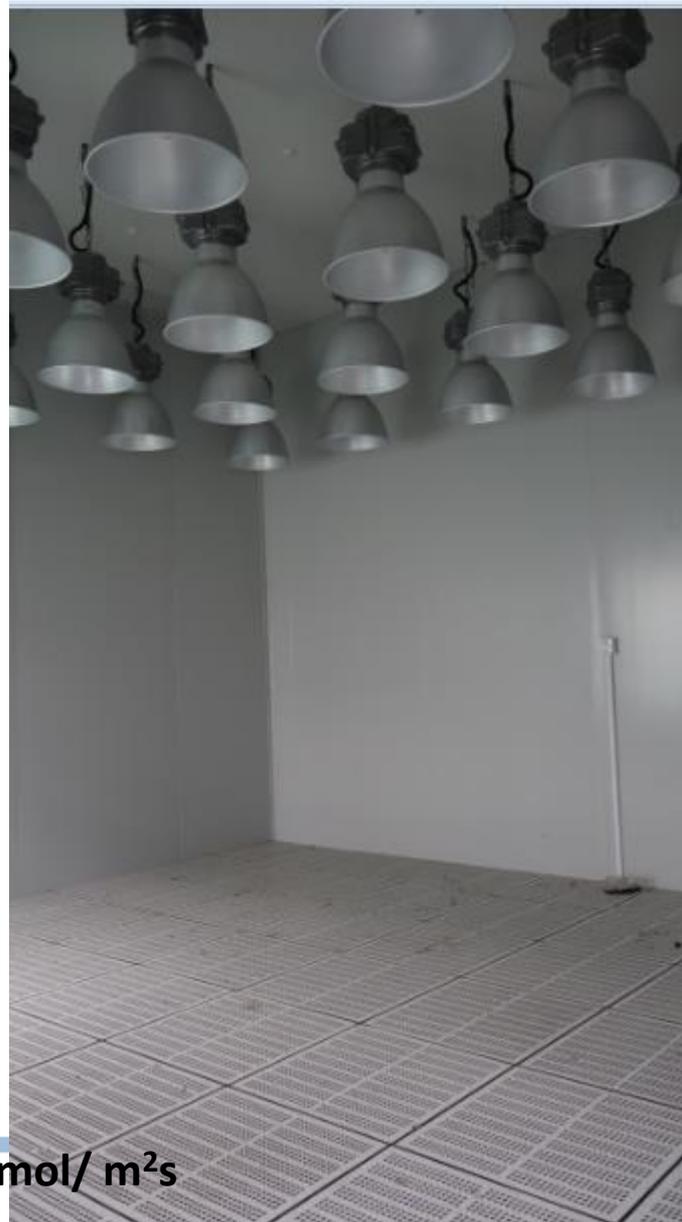
CONVIRON BDW80步入式植物培养室



人工气候室建设



GE氙钠灯和金卤灯模组

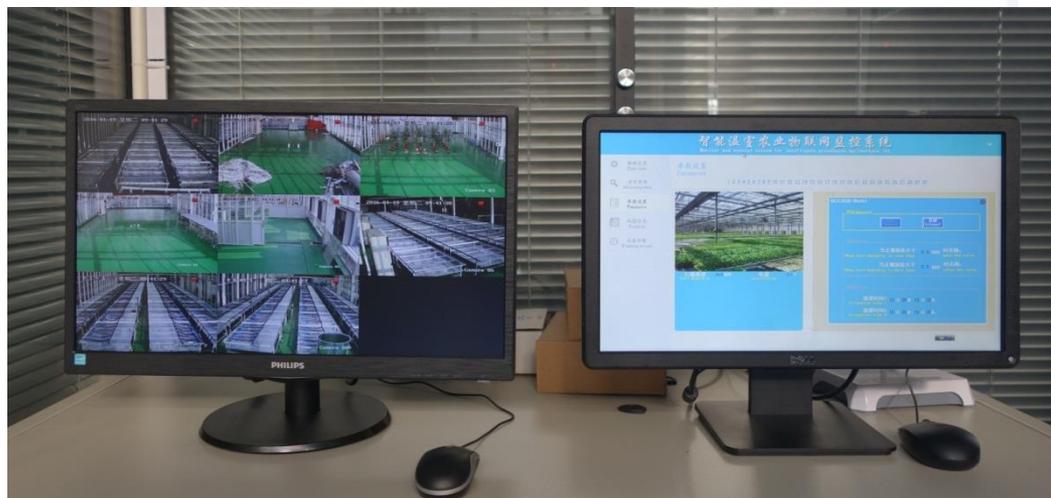
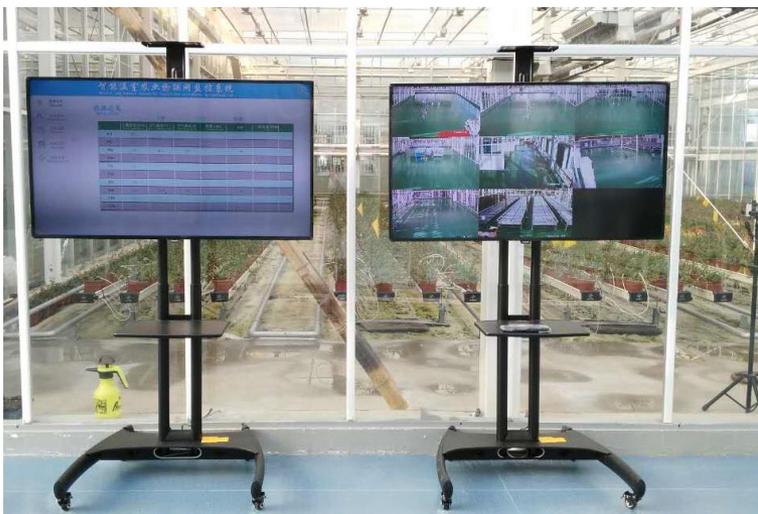


16~32°C ±1°C

45%-75% ±5%

200~600 $\mu\text{mol}/\text{m}^2\text{s}$

农业物联网建设



农业物联网建设的各项配件

栽培仓改建-潮汐灌溉



潮汐灌溉移动苗床



潮汐灌溉苗床的应用



潮汐灌溉控制器



栽培仓改建-移动苗床



增加滴灌系统的移动苗床



移动苗床



环境监控系统

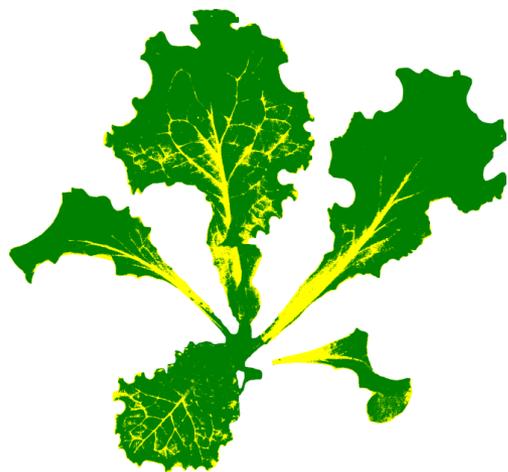


360度无死角摄像头

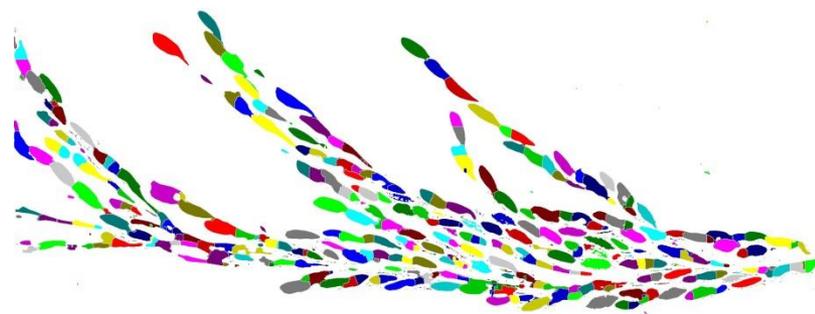
环境监控摄像头



zealquest®



AgriPheno™ 科研服务



泽泉项目管理系统-lims



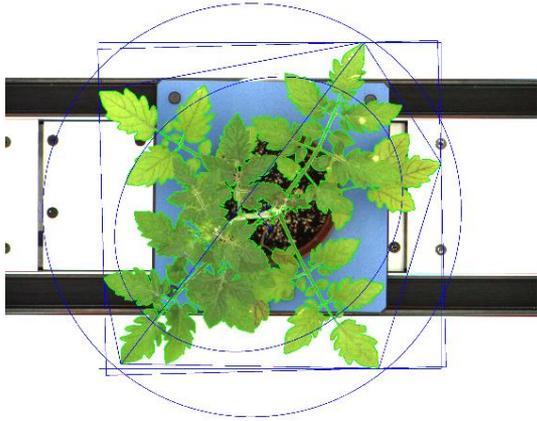
hongmei.he
admin,平台主管

个人工作台

- 项目管理
- 发展部项目管理
- 实验材料管理
- 仪器管理
- 试剂耗材管理
- 温室数据
- 系统设置

创建项目

	项目类型	项目名称	项目编号	项目状态	项目开始日期	项目负责人	项目客户	方案评审状	操作
1	免费项目	不同品种拟南芥衰老表型研究	AP20160620-YH07-SHZU	项目进行中	2016-10-21	李瑞,周晓双,姜楠	熊杏杏	无方案	查看详情 编辑 关闭项目
2	普通	应用植物多酚-叶绿素测定计...	AP20160907-10-SHJTU	项目进行中	2016-09-19	李瑞	杨晓	无方案	查看详情 编辑 关闭项目
3	免费项目	不同处理下小麦表型分析	AP20160405-YH01-ECNU	项目进行中	2016-04-05	李瑞,周晓双	罗音	通过	查看详情 编辑 关闭项目
4	普通	应用高通量表型平台分析水分...	AP20160329-01-SHJTU	项目进行中	2017-04-03	何红梅,周晓双,...	上海交通大学	待评审	查看详情 编辑 关闭项目
5	普通	青菜高通量表型图谱标准的建...	ZQ20161205-13-SHAS	项目进行中	2016-12-05	李霞,周晓双,张...	上海泽泉科技股	待评审	查看详情 编辑 关闭项目
6	普通	菜心耐热性表型和生理分析	AP20160920-11-FSSNKS	项目进行中	2016-11-01	王玉杰,周晓双	佛山市农业科学	待评审	查看详情 编辑 关闭项目
7	普通	丹参地上部表型分析	AP20160929-12-TSMMU	项目进行中	2016-09-29	王玉杰,周晓双	长征医院 陈军锋	待评审	查看详情 编辑 关闭项目



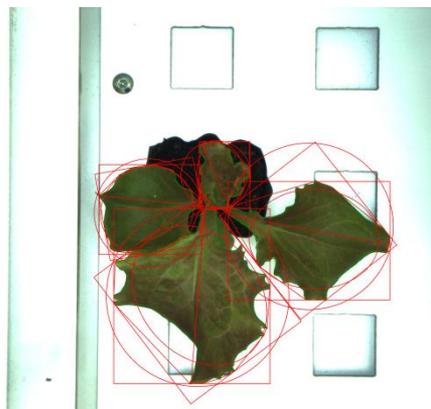
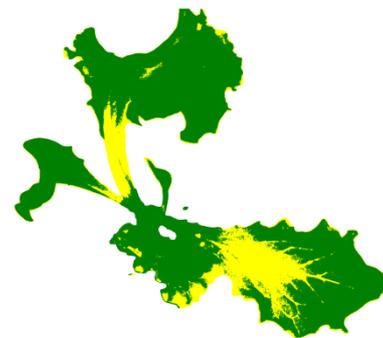
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AP20151102-11-SJTU



已结题项目

杨树表型与生理性状分析 AP20151105-12-SIPPE



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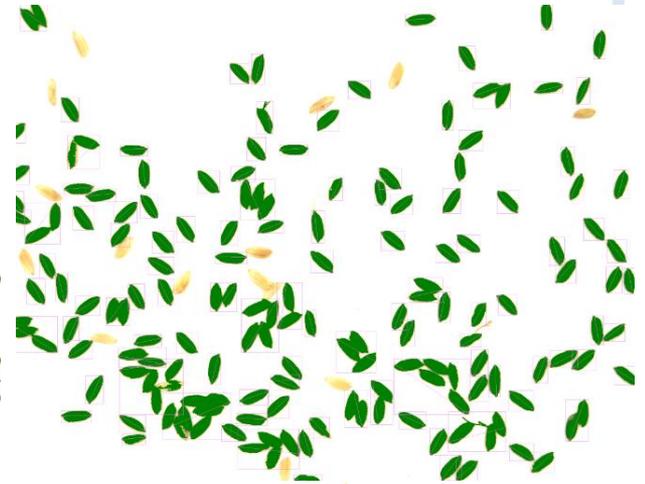
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拟南芥干旱表型及光合生理研究

HN-20150916



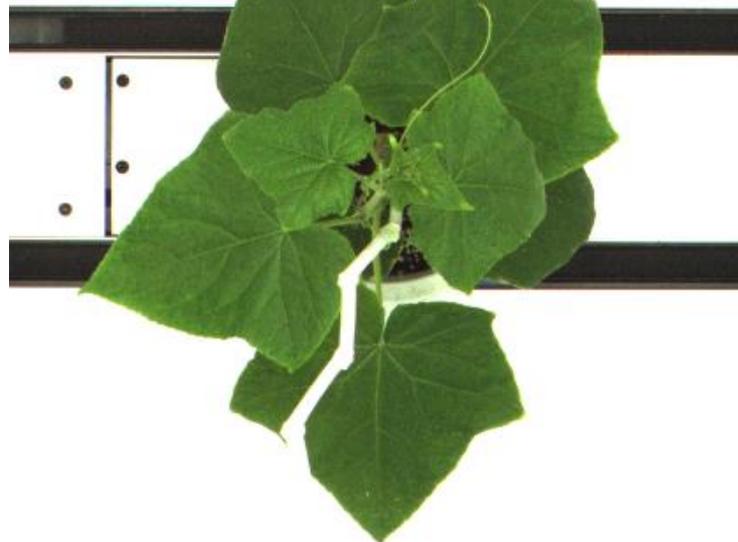
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基于图像分析及三维建模技术的黄瓜长势快速评价方法研究

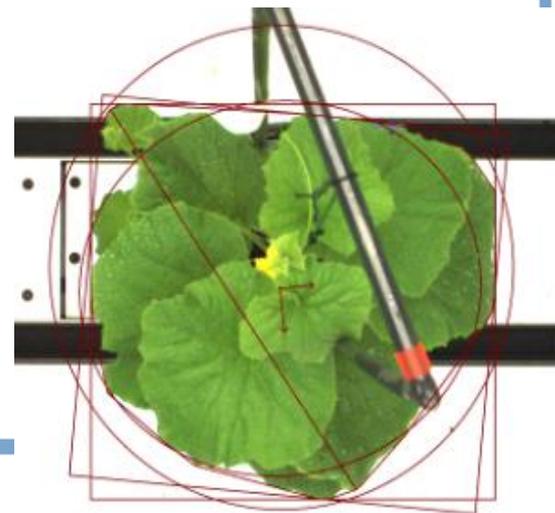
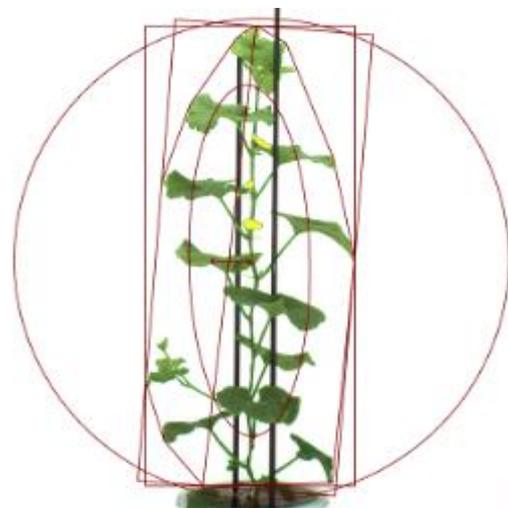
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应用高通量表型平台分析水分对甜瓜的影响

AP20160329-01-SHJTU



在研项目

丹参地上部表型与地下部根生长相关性分析

AP20160426-03-TSMMU

AP20160426-04-TSMMU



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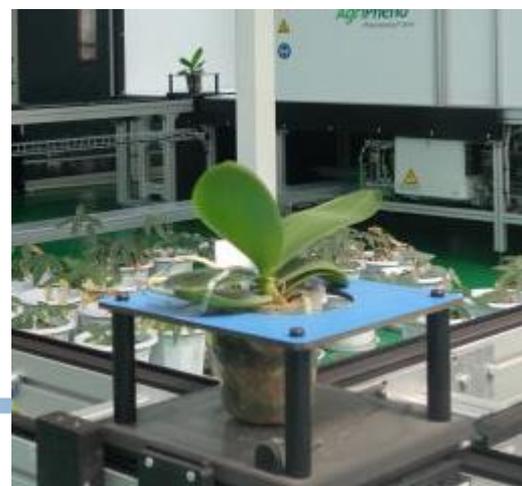
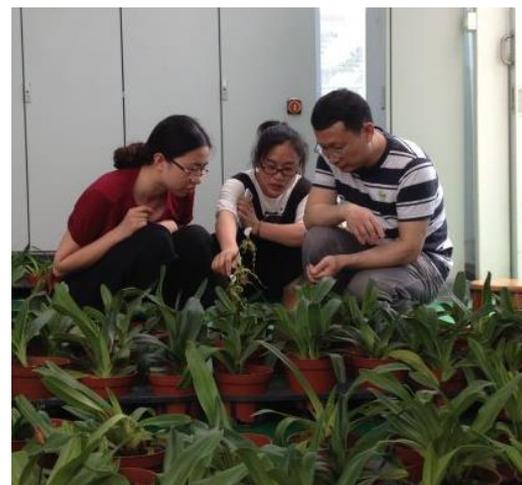
不同培养条件下烟草种子萌发特征研究

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在研项目

科观赏花卉分子育种技术与产业化应用 AP20160816-09-SLF



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菜心耐热性表型和生理分析

AP20160920-11-FSSNKS



在研项目

青菜高通量表型图谱标准的建立 ZQ20161205-13-SHAS

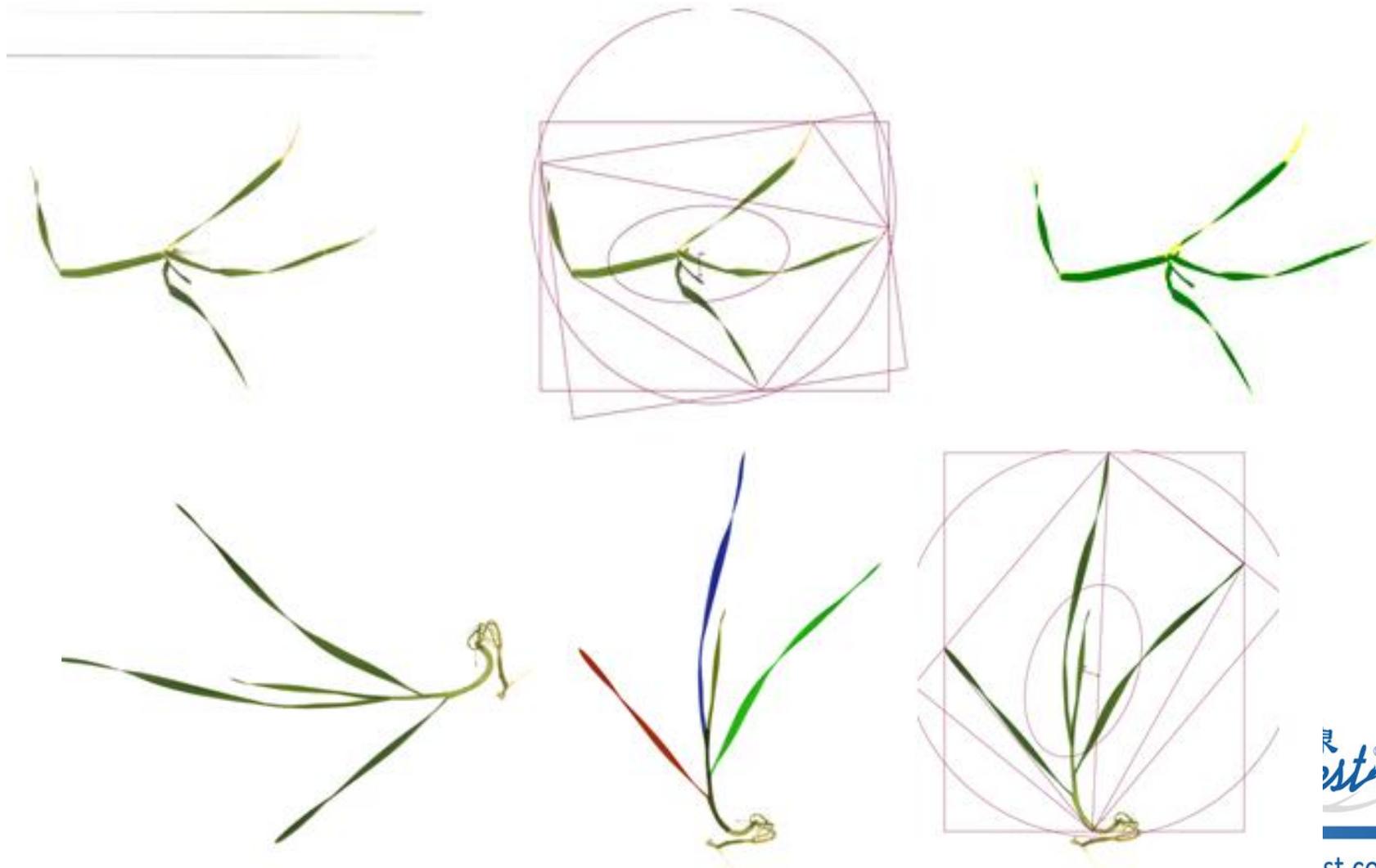


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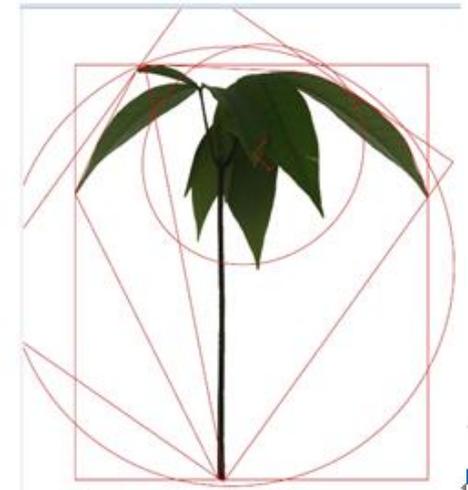
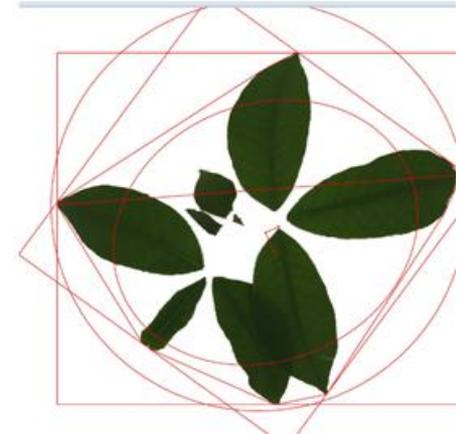
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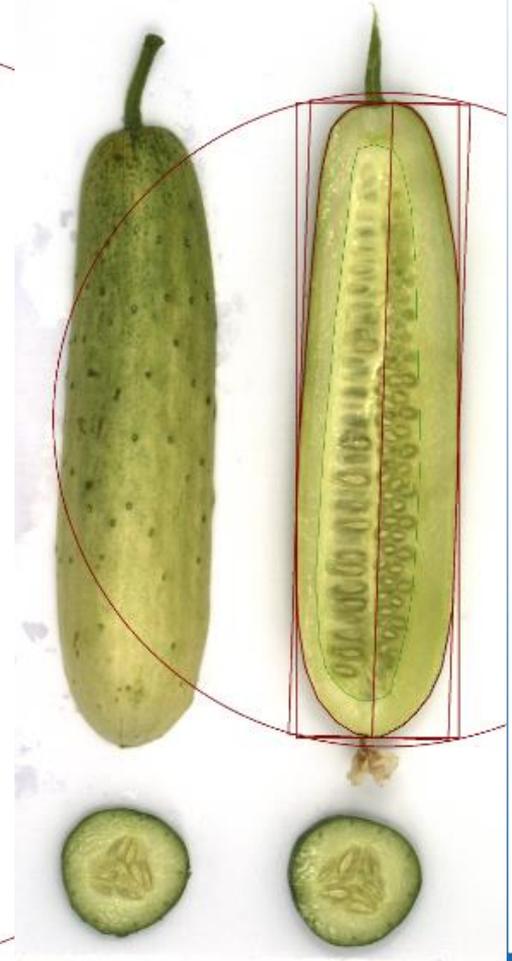
橡胶种子萌动至幼苗各个时期表型成像分析

AP20160405-YH02-CATAS



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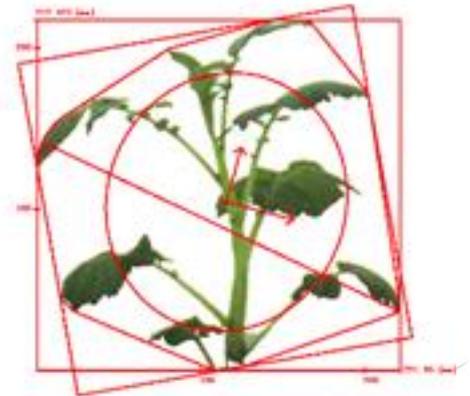
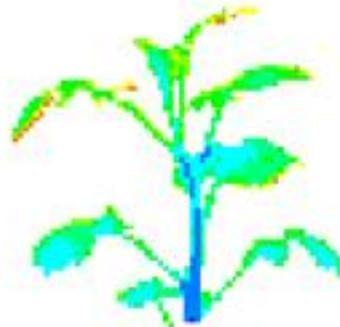
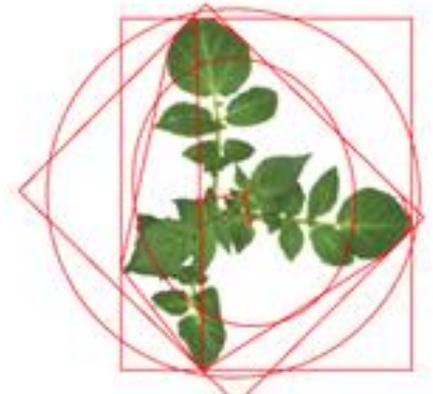
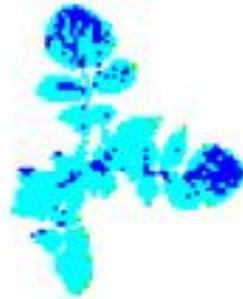
四种黄瓜品种的表型分析 AP20160704-YH06-TASSA



内部课题

基于图像分析和模型建立的马铃薯长势评价方法研究

AP20160405-ZY01-AP



谢谢大家！

