Delta-T Devices

WinDIAS 3

Image Analysis System

Image analysis system for leaves

WinDIAS provides rapid measurement and analysis of leaf area and leaf features- ideal for plant pathology and phenotyping applications

- **Advanced leaf area meter - plus perimeter, length, width, object count and more**
- **Automated measurement of diseased, healthy and pest-damaged leaf area**
- **Point and click colour selection**
- **Choice of camera or scanner systems**
- **Conveyor option for high speed leaf processing**

WinDIAS's powerful analysis features are well suited to applications in the plant sciences, particularly plant pathology and phenotyping, where precise colour discrimination is critical.

Images are acquired using either a high resolution video or an A4 scanner. Alternatively, image files can be imported from other sources.

With the conveyor belt option, WinDIAS can process up to 800 leaves per hour.

The LED top-lights provide flicker-free illumination and achieve good colour balance. In addition, the LED lights are cool running, improving operator comfort.

For reporting and further analysis, all results and images from WinDIAS are easily exchanged with other Windows applications.

Applications

- **Plant pathology**
- **Phenotyping**
- **Agronomy and plant physiology**
- **Forestry**
- **Object counting**

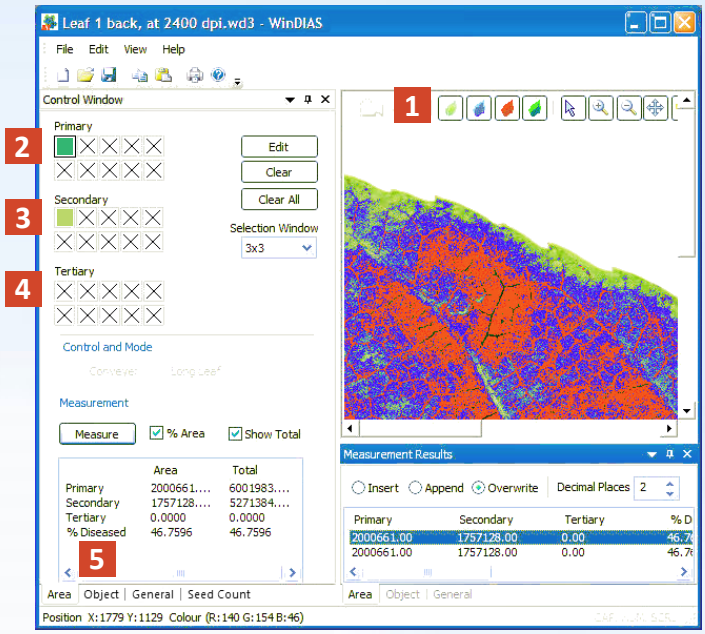
New for 2019

- Lower prices for conveyor systems
- LED lighting with adjustable brightness
- Improved seed counting capability
- Improved Area of Interest drawing tool

Rapid Analysis of Healthy and Diseased Leaf Area

- **Quick function tool bar (1)**
- **Colours picked to set primary threshold colour range (2)**
- **Colours picked to set secondary (3) and tertiary (4) colour range**
- **Results box showing healthy and diseased areas (5)**

Point and click colour selection



WinDIAS Features

Rapid thresholding: Three thresholds can be set, each based on a different user-defined range of colours. The primary threshold is used for the main zones of interest in the image, e.g. healthy areas. The secondary and tertiary thresholds are used for other zones, e.g. diseased areas. Thresholds are set by a simple point and click with the mouse in a region of interest. The areas included are immediately visible as overlays on the image.

Editing: Images can be edited on-screen to retouch boundaries, separate objects that overlap, remove undesirable "noise" and holes, add or erase lines or rectangles, and fill bounded areas in any colour.

Measurement: WinDIAS analyses the thresholded regions to measure area, perimeter, length, width, circularity, elongation and shape factor. Calibration is carried out against a ruler.

Object count: Seeds, needles, or other small objects can be quickly counted by WinDIAS. Colour thresholding enables easy discrimination of different types of object, or disease spots. Dust and debris can be excluded by defining a minimum object area.

Exchange of data and images: WinDIAS imports images in .bmp, .jpg and .tif formats, and results can be saved as .txt files for easy import into Excel.

Fast batch processing of image files: WinDIAS can automatically analyse large numbers of leaf images by operating as a virtual conveyor. This feature saves a great deal of time when processing images acquired in the field or when sent in for processing from a remote research lab. Images in bmp, jpg, or tiff format are all suitable for processing.

Batch processing mode is simple to use - just select the folder holding the target images. WinDIAS will then automatically load each image in turn, measure it, and save the results back into the same folder.

WinDIAS System Choices - WinDIAS is modular and expandable	
System type	**Features and advantages**
WinDIAS 3 Entry Level System The Entry Level System includes the scanner and WinDIAS software only	The Entry Level System enables the full set of analysis features and can be used at very high resolution up to A4 size, but is slow – it may take ~1 minute to scan and analyse each image at higher resolutions.
WinDIAS 3 Standard System Includes USB colour video camera, camera stand, lightbox, overhead lighting rig and WinDIAS software	The Standard System enables full analysis of static objects illuminated by a lightbox and overhead lights. Typically 2 or 3 images can be processed per minute. The Standard System can be later upgraded to the Rapid specification by adding a Conveyor Belt Unit. (See upgrades on page 4).
WinDIAS 3 Rapid System Includes all the Standard System components plus the Conveyor Belt Unit	The Rapid System includes the Conveyor Belt Unit, enabling the rapid processing of leaves and the measurement of long leaves (up to 100 cm). Full analysis of static objects can also be performed, as with the Standard System.

Applications

Agronomy, plant physiology and phenotyping

WinDIAS provides a flexible resource with countless laboratory applications- from simple leaf area measurement to the analysis of complex distributions of colour. The addition of the Conveyor Belt accessory opens up further applications - see below.

Forestry

For broadleaf species, all of the applications described above are applicable. It is also possible to use WinDIAS with conifers; the surface area of pine needles can be estimated by multiplying the projected area by a conversion factor. Factors for Corsican Pine (*Pinus nigra var maritima*), Scots Pine (*Pinus sylvestris*) and general conversion factors are included in the WinDIAS User Manual.

Standard System

Plant pathology and crop protection

WinDIAS is optimised for the rapid analysis of area by colour difference, creating many applications in plant pathology and plant protection. Examples include: necrosis caused by fungi and bacteria, leaf tip burn and leaf spotting, nutrient deficiency symptoms, viral infection and leaf senescence.

By pointing and clicking with the mouse on the leaf image, the colours of healthy regions can be tagged one by one, followed by the colours of two different types of diseased regions (e.g. diseased and necrotic).

Regions whose colours are within the primary, secondary and tertiary colour ranges will show immediately as overlays on the video image, quickly indicating whether the required areas have been detected. WinDIAS can then measure the healthy and diseased areas and perform other measurements.

Other applications

WinDIAS can measure much more than leaves. For example, it can assist with the analysis of aerial photos to estimate ground cover, and can be used with a suitable zoom lens or a USB microscope to measure and count very small objects.

Conveyor Belt Unit

- Rapid throughput of large numbers of leaves
- Measurement of intact long leaves e.g. maize, sorghum, sugar cane and miscanthus

The Conveyor Belt Unit works with WinDIAS to provide a rapid and convenient method of handling large batches of leaves. Twin transparent belts carry the leaves past the camera. A lightbox provides background illumination and top lighting optimises colour discrimination.

Long leaves: With the addition of the Conveyor Belt Unit, WinDIAS can measure leaves which are too long to fit in the field of view of the video camera. WinDIAS software repeatedly samples the leaf image as it moves past the camera at constant speed. Stored data sets include total area and the percentages of healthy and diseased leaf area. Typically, a leaf 30 cm long by 2 cm wide can be measured in 4 seconds.

Conveyor Belt Unit and Lightbox

WinDIAS Specifications

	Entry Level System	Standard System	Rapid System
Throughput (leaves/hour)	~50 (typical, depends on leaf size)	~150	~800
Resolution	Typically >1000 dpi	2056 x 1542 pixels	2056 x 1542 pixels
Minimum object size	~0.02 mm	1 pixel	1 pixel
Maximum sample area	297 x 210 mm (A4)	300 x 295 mm	250 x 290 mm (conveyor) 250 x >1000 mm (long leaf mode)
Accuracy			
area measurement	± 1% typical	± 4% typical	± 4% typical
diseased/healthy area	contrast dependent	contrast dependent	contrast dependent
long leaf mode	not applicable	not applicable	± 5% typical
Calibration			
static measurements	against object of known length, e.g. a ruler	against object of known length, e.g. a ruler	against a ruler
conveyor measurements	not applicable	not applicable	against a target of known area
Conveyor belt speeds	not applicable	not applicable	60/100/140/190 mm/s (20% faster for 60 Hz model)

Colour depth	WinDIAS works in 24 bit colour space (16 million colours)
Image file formats	.jpg, .bmp and .tif (WInDIAS is compatible with many scanners and cameras that are TWAIN compliant)
Operating system & drivers	Windows 7,8 and 10 (32 and 64 bit)

Specifications apply to a WinDIAS system using standard components supplied by Delta-T Devices. Use of other cameras, lighting systems or camera stands may reduce accuracy due to reflections, poor contrast or image distortion.

Ordering Information

WinDIAS Systems

WinDIAS 3 Entry Level Image Analysis System type WD-E3
(230v/110V) includes WD-SW3 Software and WD-FBS-1 Flatbed Scanner.

WinDIAS 3 Standard Image Analysis System type WD-S3-230/110
(230V/110V) includes WD-SW3 Software, WD-CS1 Camera Stand, WD-CAM-R1 USB Colour Camera, WD-LEN-1 Precision Lens, WD-LB2 Lightbox, WD-OL1 Overhead Lights and acrylic sheets. *Requires correct IEC mains lead – please see right "Mains Lead types"*

WinDIAS 3 Rapid Image Analysis System type WD-R3-230
(230V/50Hz) contents as listed for Standard System, plus CB-230/50 Conveyor Belt Unit. *Requires correct IEC mains lead – please see right: "Mains Lead types"*

110V 60 Hz and 220V 60 Hz Systems: The Entry Level and Standard Systems are both dual voltage 110V/230V. The Rapid System is 230V 50 Hz only. This is because we cannot supply 110 V Conveyor Belt Units. We can, however, supply 220 V 60 Hz Conveyor Belt Units- please enquire for further details.

Upgrades

Software: Customers using older version of WinDIAS software can upgrade to the new version (v3.3) free of charge, by downloading it from www.delta-t.co.uk (requires USB Copy Protection Dongle that came with the original software).

Hardware: Users of Standard WinDIAS Systems supplied after March 2019 can upgrade to the Rapid System simply by ordering a Conveyor Belt Unit (subject to voltage type). Users of older WinDIAS systems wishing to update the lighting or add a Conveyor Belt Unit should contact Delta-T for guidance software.

Entry Level System
- Flatbed Scanner

System Components

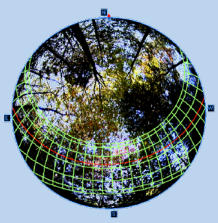
WinDIAS Software type WD-SW3 Software, Quick Start Guide and USB copy protection dongle
Camera Stand type WD-CS1
Camera type WD-CAM-R2 Colour Camera for use with the Standard and Rapid WinDIAS Systems
Precision Lens type WD-LEN-1 for use with WD-CAM-R2
Lightbox type WD-LB2 LED Lightbox for WinDIAS
Overhead Lights type WD-OL1 LED Overhead Lights
Conveyor Belt Unit type CB-230/50 (230 V/50 Hz)
Flatbed Scanner type WD-FBS-1 A4 Flatbed Scanner
Acrylic Sheets type WD-AS1 Transparent sheets to hold and flatten leaves (pack of 10)
Mains Lead types PC-UK, PC-EU, PC-US, PC-IN, PC-CN connects national plug to WInDIAS IEC connector. Required for WinDIAS systems type WD-S3-230/110 and WD-R3-230.

Accessories and Spares

Reference Target Set type WD-RTS-1 Colour rendition chart and reference targets for WInDIAS
Spare Conveyor Belt Material type CBSP1 Enough to make 10 pairs of belts [for 50 pairs order type **CBSP2**]
Conveyor Spares type CBSP3 Full set of "O" rings and two drive bands for Conveyor Belt Unit

LAI - Leaf Area Index

There are more ways of getting to LAI than just measuring individual leaves. We also offer SunScan and HemiView - two innovative techniques for estimating LAI non destructively in crop and forest canopies.



Visit our website to view WinDIAS introduction VIDEO >>> www.delta-t.co.uk

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