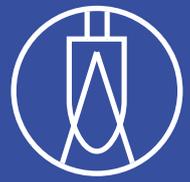


# DUALEX SCIENTIFIC+™



## POLYPHENOL & CHLOROPHYLL-METER



- ▶ REAL-TIME
- ▶ GEOLOCATED
- ▶ NON-DESTRUCTIVE
- ▶ ANY PLANTS & LEAVES
- ▶ MEASUREMENTS RECORDED & SORTED

# DUALEX SCIENTIFIC+™, AN INNOVATIVE TOOL

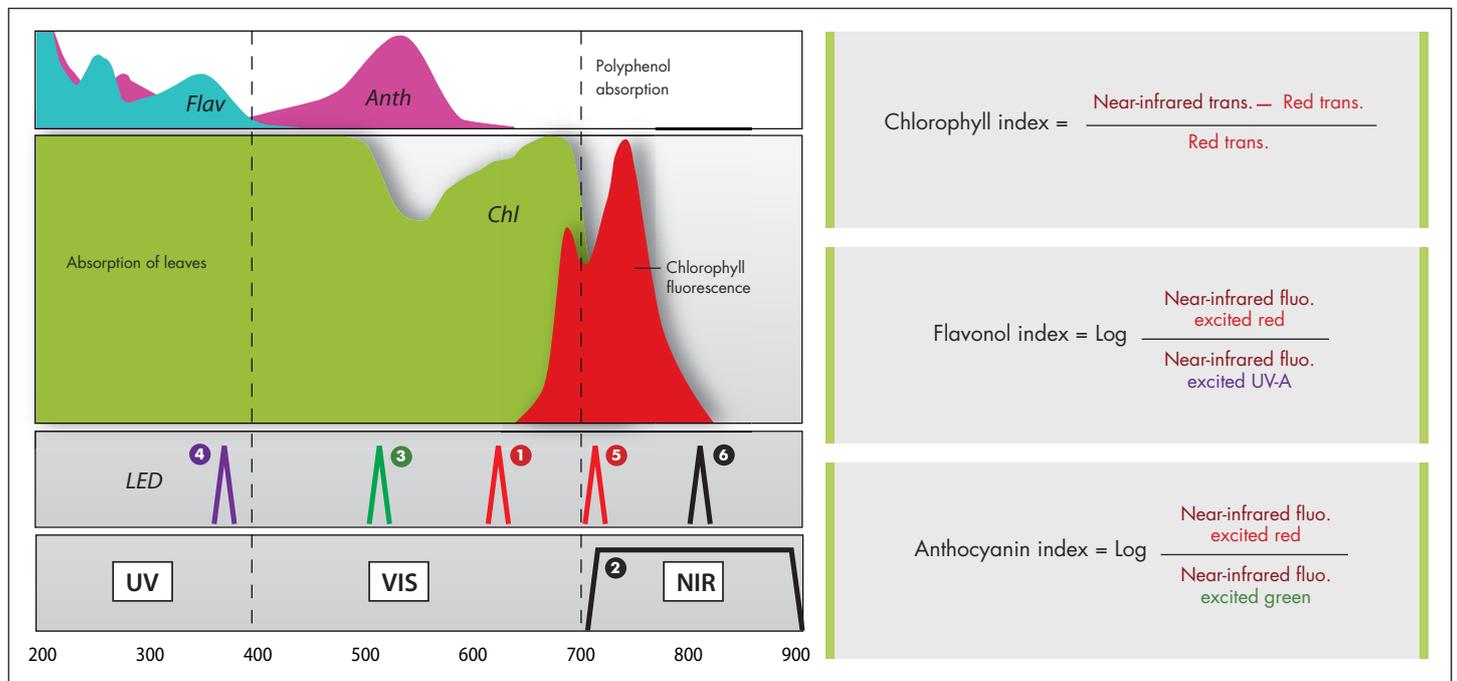
Based on research of the CNRS (National Center for Scientific Research) and the University of Paris-Sud Orsay, this new leaf clip can simultaneously and accurately monitor the chlorophyll content in leaves, flavonol and anthocyanin contents in the epidermis. Versatile, it is dedicated to plant science and agronomy. Applied equally on monocots, dicots or perennials, this tool is simple to use. Measurements are instantaneous and non-destructive. They require no prior calibration, and no sample preparation. Therefore, measurements can either be done in the laboratory or in the field, under all conditions of temperature and ambient light.

## POLYPHENOLS measurement

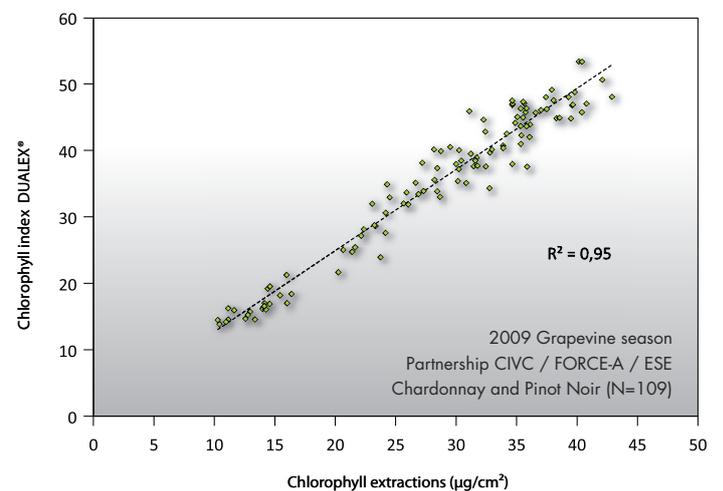
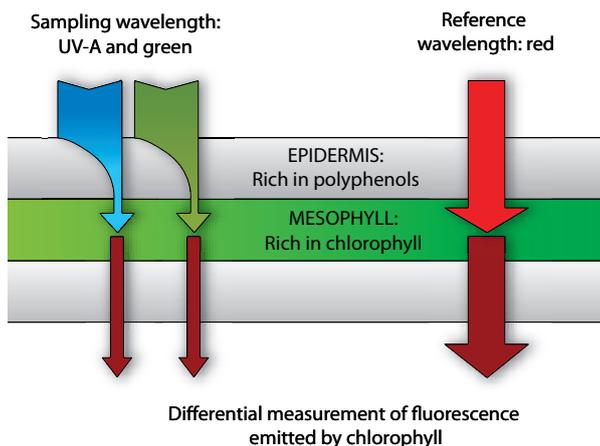
Near-infrared chlorophyll fluorescence **2** is measured under a first reference excitation light **1** not absorbed by polyphenols. It is compared to a second sampling light specific to a particular type of polyphenols (e.g. green **3** for anthocyanins or UVA **4** for flavonols). Only a fraction of this light reaches the chlorophyll in the mesophyll and can generate near-infrared fluorescence.

## CHLOROPHYLL measurement

The leaf chlorophyll content can rapidly and accurately be assessed from light transmission. A first wavelength very close to the red **5** quantifies the chlorophyll and a second in the near-infrared **6** can take into account the effects of leaf structure.



The difference in chlorophyll fluorescence measured in the near-infrared is thus directly proportional to the amount of polyphenols present in the epidermis of the leaf.



## Strengths

### ■ LIGHTWEIGHT AND COMPACT

Very light (only 220 g, battery included) and compact (it fits into the hand), the DUALEX SCIENTIFIC+™ is easily portable and can be used frequently. Its ergonomics is specifically designed to measure leaves from 0.5 to over 16 cm wide.

### ■ SIMPLE MEASUREMENTS

In automatic mode, the measurement is recorded each time the device detects the presence of a leaf (manual triggering also available).

### ■ ADAPTED TO EXPERIMENTATION

The DUALEX SCIENTIFIC+™ offers the option to remove the last measurement, to manage measurement groups (three levels of classification), and to record more than 10,000 multiparametric measurements with additional information: date, time, group number and GPS position (meter accuracy).

### ■ CUSTOMIZABLE

It is possible to customize the indices displayed by the fluorometer, which influences the sensor final price.

### ■ EASY DATA MANAGEMENT

Data can be downloaded via USB in a format compatible with any data processing software.

### ■ INTERNAL GPS (AS AN OPTION)

The DUALEX SCIENTIFIC+™ comes with an internal GPS which allows to do mapping.

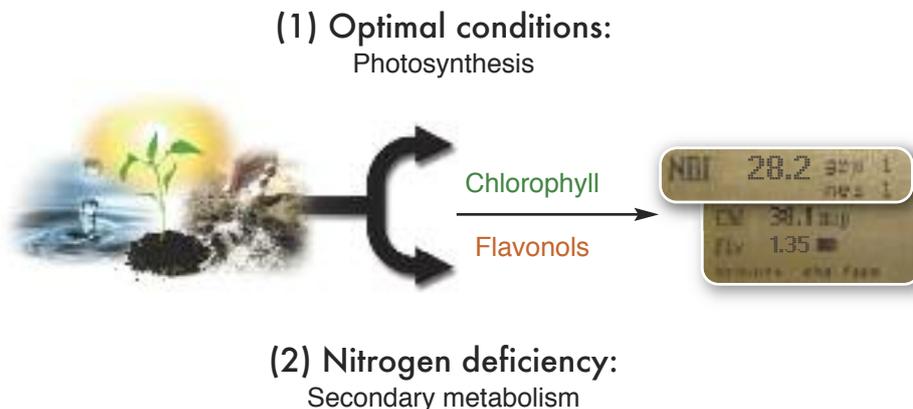
### ■ LONG AUTONOMY

Its rechargeable Li-ion high-capacity battery is guaranteed for 1,000 charging cycles. Thanks to the technology used, the device can achieve up to 25,000 measurements for a charging time of 4 hours.

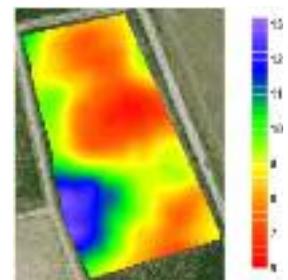


## EXAMPLE OF APPLICATION: MONITORING OF NITROGEN STATUS A NEW INDEX: THE NBI®

Several years of research and experimentation showed that polyphenols, specifically flavonols, are indicators of nitrogen status of plants. Indeed, when a plant is under optimal conditions (1), it favours its primary metabolism and synthesises proteins (nitrogen-containing molecules) containing chlorophyll, and few flavonols (carbon-based secondary compounds). On the contrary, in case of nitrogen deficiency (2), the plant directs its metabolism towards an increased production of flavonols as shown on the diagram below:



### NBI® MAPPING OF A VINEYARD



By using a new indicator called NBI® (Nitrogen Balance Index) which is the ratio Chlorophyll/Flavonols (related to Nitrogen/Carbon allocation), it is now possible to get an earlier information about the nitrogen status of cultures.

# DUALEX SCIENTIFIC+™ TECHNICAL SPECIFICATIONS

<b>Measured material</b>	Leaf
<b>Measured parameters</b>	4 measured indices Chl: chlorophyll index Flav: flavonol index NBI®: nitrogen status, Chl/Flav ratio Anth: anthocyanin index
<b>Measurement process</b>	Automatic or manual
<b>Measured area</b>	5 mm in diameter
<b>Sample thickness</b>	1 mm maximum
<b>Measurement area access</b>	8.5 cm maximum (half-leaf width)
<b>Acquisition time</b>	< 500 ms
<b>Storage capacity</b>	10,000 multiparametric measurements
<b>Data classification</b>	3 levels (file, group and measurement numbers)
<b>Temperature range</b>	From 5 to 45°C
<b>Light sources</b>	5 LED: 1 UV-A, 1 red and 2 near NIR (near-infrared)
<b>Detector</b>	1 silicon photodiode
<b>User interface</b>	LCD screen Sound warning
<b>Data downloading</b>	USB connexion for data transfer
<b>Battery</b>	Li-ion rechargeable battery
<b>Battery life</b>	10 hours
<b>Charging time</b>	4 hours
<b>Total weight</b>	220 g (with battery)
<b>Size</b>	205 mm x 65 mm x 55 mm
<b>Positioning</b>	Internal GPS
<b>Relative precision</b>	< 2.5 m (CEP, 50%, 24 h static)
<b>Languages</b>	English, French, Spanish and German
<b>Safety</b>	Ring for leash
<b>Updating</b>	Remote program updating



## REFERENCES

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- Cerovic, Z.G., Masdoumier, G., Ben Ghazlen, N., Latouche, G. (2012) A new optical leaf-clip meter for simultaneous non-destructive assessment of leaf chlorophyll and epidermal flavonoids. *Physiologia Plantarum*, ISSN 0031-9317.