

*Fluorescence and  
Optoelectronics  
Research for the  
Communication  
between  
Ecophysiology and  
-  
Agriculture*

# *Real-Time Optical Solutions for Sustainable Agriculture*



## DUALEX 3 Series

june 2007

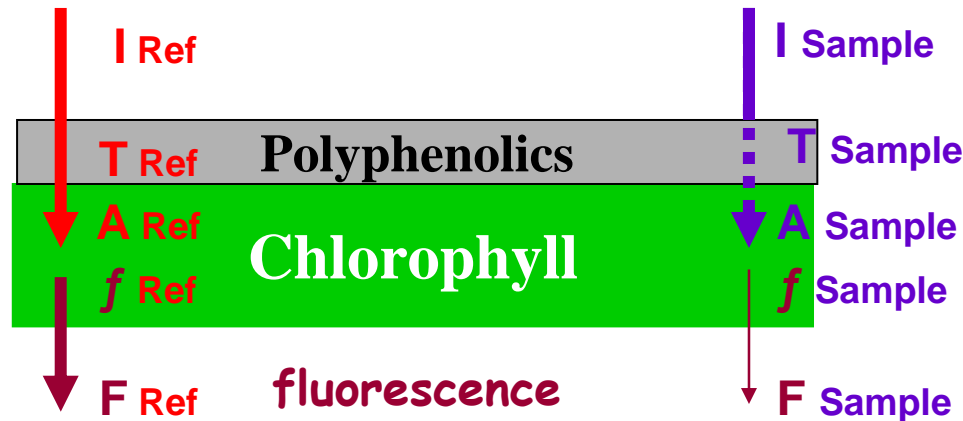






## Dualex

- Non-destructive, fast and easy-to-operate
- Field measurements
- No preparation of the plant
- Any ambient light conditions
- User-friendly leaf-clip design



**I Ref = REFERENCE LIGHT EXCITATION**

**I Sample = SAMPLE LIGHT EXCITATION**

**I = IRRADIANCE**

**T = EPIDERMAL TRANSMITTANCE**

**A = MESOPHYLL ABSORBANCE**

**f = FLUORESCENCE YIELD**

**F = CHLOROPHYLL FLUORESCENCE**

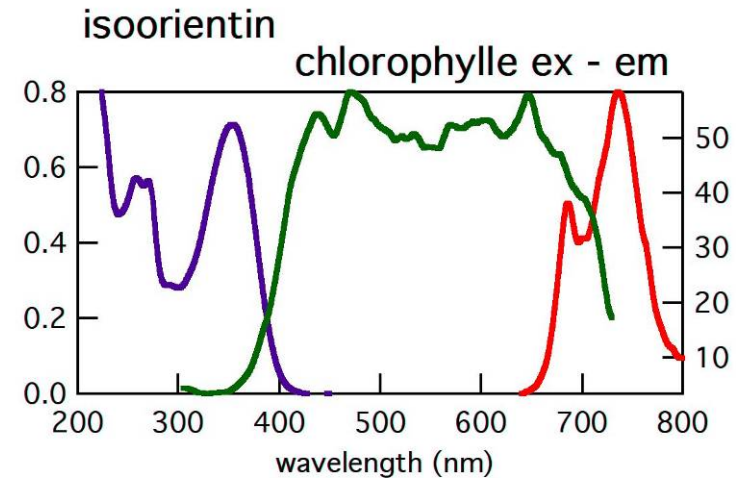
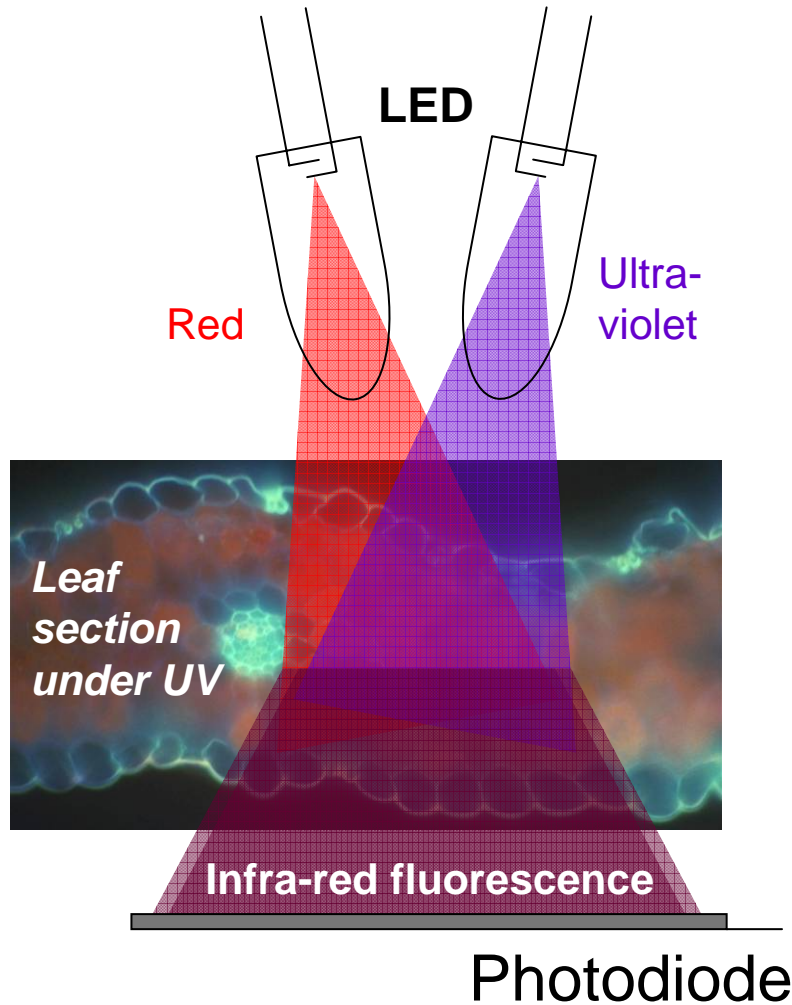
$$F_{Ref} = I_{Ref} * T_{Ref} * A_{Ref} * f_{Ref}$$

$$F_{Sample} = I_{Sample} * T_{Sample} * A_{Sample} * f_{Sample}$$

for **T Ref = 1** and  $\frac{I_{Ref} * A_{Ref} * f_{Ref}}{I_{Sample} * A_{Sample} * f_{Sample}} = \text{constant}$

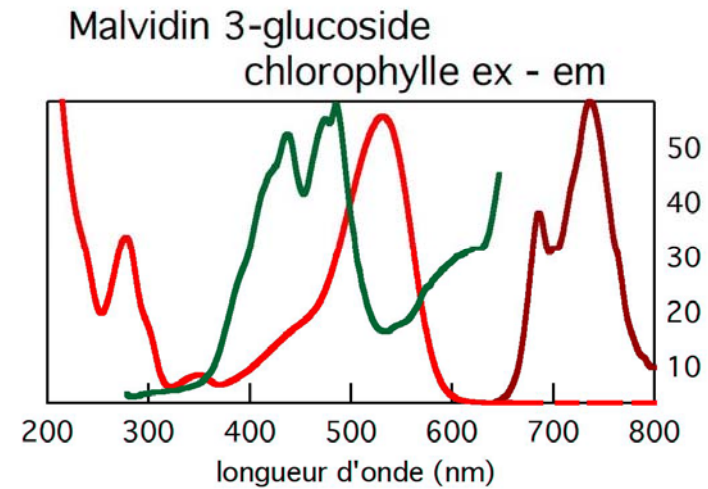
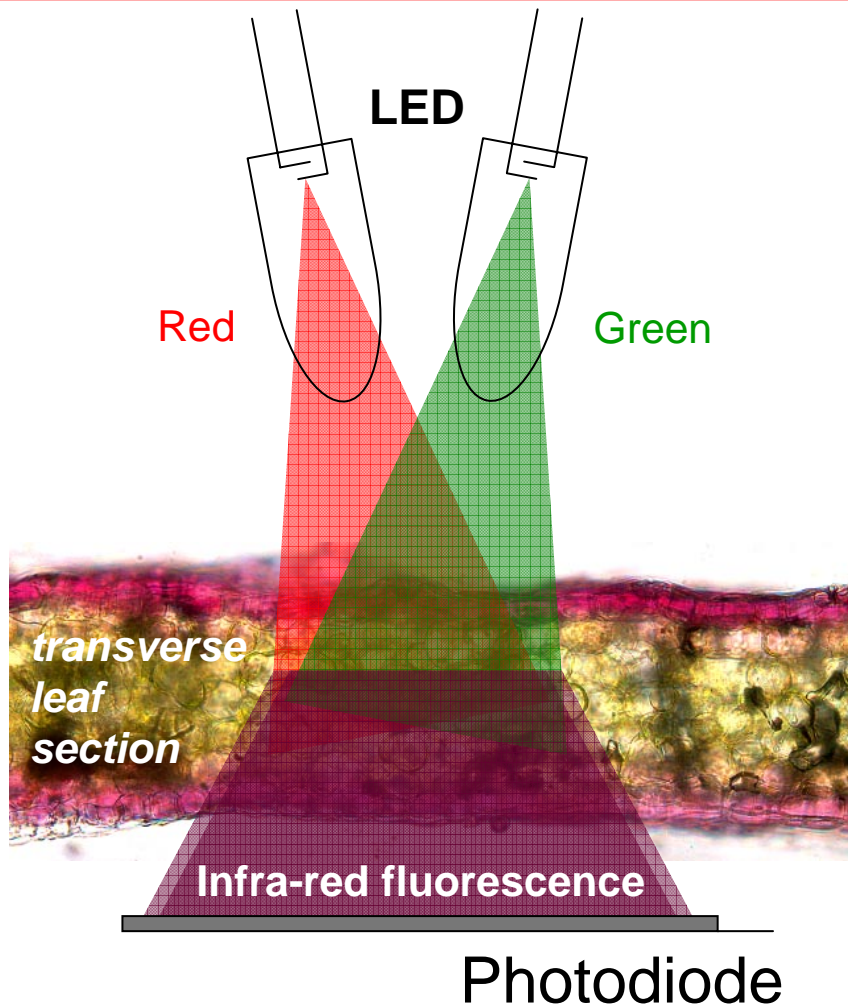
$$\log \frac{F_{Ref}}{F_{Sample}} = \log \frac{1}{T_{Sample}} = A_{Phen}$$

Goulas et al., Applied Optics 43, 4488-4496



Flavonoids are present in the epidermis. They absorb UV radiation and screen the mesophyll. Hydroxycinnamic acids absorb further UV.

Chlorophyll from the mesophyll emits near-IR fluorescence measurable on both sides of the leaf.



When anthocyanins are present in the epidermis they absorb green light and screen the mesophyll.

Chlorophyll from the mesophyll emits near-IR fluorescence measurable on both sides of the leaf.