

## $F_V/F_M$ Meter - Reliable & Affordable

The most affordable modulated fluorometer for use with *dark clips*



### $F_V/F_M$ Meter: modulated light chlorophyll fluorometer

- Measures  $F_V/F_M$  &  $F_V/F_O$ ,  $F_M$ , &  $F_O$
- Affordable dark adaption clips make measurements of large plant populations in the field much more fun!  
Price includes 10 dark clips!
- The  $F_V/F_M$  Meter is *field proven*
- Graphic display of measurement
- 2 Gigabyte memory
- USB port data transfer
- Automated modulated light intensity set up option
- Screen visible in bright sun light
- Red 660 nm modulated light source
- Up to 6,000  $\mu\text{mols m}^{-2} \text{s}^{-1}$  saturation intensity
- USB battery - 8 hour charge life

$F_V/F_M$  is the **gold standard** of chlorophyll fluorescence measurement

Why is  $F_V/F_M$  considered the gold standard of chlorophyll fluorescence measurement?

Because  $F_V/F_M$  allows the comparing of plant samples using a normalized ratio at the same known common dark adapted state and values generally correlate to photosynthesis measurement.

For specific results on different types of plant stress measurement, a Plant Stress Guide is available for free from our website. [www.optisci.com](http://www.optisci.com)

### Using $F_V/F_M$

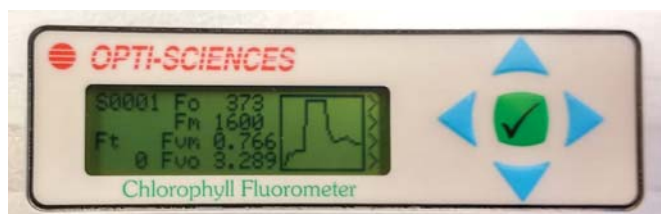
While optimal  $F_V/F_M$  values vary by plant species between 0.79 to 0.83, lower  $F_V/F_M$  values indicate that plant stress is affecting photosystem II.

For a review of specific  $F_V/F_M$  results on all types of plant stress measurement, a Plant Stress Guide is available from our website.

Normalized ratio:  $F_V/F_M = (F_M - F_O) / F_M$

With *affordable dark adaption clips* it is possible to measure the “equivalent” of “predawn dark adaption” samples at more practical times of day. They are also handy for shorter dark adaptation periods during the day. Dark clips allow rapid measurement of more *statistically significant plant populations*.

# F<sub>V</sub>/F<sub>M</sub> meter



Measuring display and control panel



Dark adaption clips - The F<sub>V</sub>/F<sub>M</sub> meter comes with 10 clips. Clips are available individually or in packages of fifty.



F<sub>V</sub>/F<sub>M</sub> meter with 36 inch USB cable and USB battery.

The F<sub>V</sub>/F<sub>M</sub> meter and the battery will fit in clothing pockets

## Journal references:

Boris LAZAREVIĆ, Tomáš LOŠÁK, Ahmad M. MANSCHADI (2018) Arbuscular mycorrhizae modify winter wheat root morphology and alleviate phosphorus deficit stress, *Plant Soil Environ.*, Vol. 64, 2018, No. 1: 47–52, doi: 10.17221/678/2016-PSE

Fernández-Marín, B., Gago, J., Clemente-Moreno, M.J. et al. "Plant pigment cycles in the high-Arctic Spitsbergen" *Polar Biol* (2019). <https://doi.org/10.1007/s00300-019-02463-x>.

Zohreh Heydarian, Min Yu, Margaret Gruber, Cathy Coutu, Stephen J. Robinson & Dwayne D. Hegedus (2018) "Changes in gene expression in *Camelina sativa* roots and vegetative tissues in response to salinity stress" *Scientific Reports* vol 8, Article number: 9804 (2018).

## Specifications:

### Measuring Parameters:

F<sub>V</sub>/F<sub>M</sub>: Maximum photochemical efficiency of PSII

F<sub>V</sub>/F<sub>O</sub>: A more sensitive detector of stress than F<sub>V</sub>/F<sub>M</sub> but it does not measure plant efficiency or correlate to photosynthesis measurements.

F<sub>O</sub>: Minimum fluorescence

F<sub>M</sub>: Maximal fluorescence

F<sub>V</sub>: Variable fluorescence

F<sub>t</sub>: Detected fluorescence signal, used to set up modulated light intensity and gain.

### Light Sources:

**Saturation pulse:** - Red 660 nm LED with 690 nm short pass filter. Intensity up to 6,000 μmol m<sup>-2</sup> s<sup>-1</sup>. Adjustable saturation pulse width.

**Modulated light:** Red: 660 nm LED with 690 nm short pass filter.

### Other Specifications:

**Detector & Filters:** A PIN photodiode with a 700 ~ 750 nm bandpass filter

**Sampling Rate:** Auto-switching from 1 to 10,000 points per sec.

**Storage Capacity:** 2 gigabyte of non-volatile flash memory,

**Special Algorithm:** 8 point rolling 25 ms average to determine highest F<sub>M</sub>, eliminates saturation pulse NPQ & any electronic noise as an issue.

**Special Algorithm:** Optimally sets the modulated light intensity. It may also be adjusted manually.

**Output:** CSV comma delineated files may be opened in any spread sheet software program. No special software is required.

**User Interface:** Display: Graphic black and white display, menu driven with arrows. 132 x 32 pixels. Designed for use in sunlight.

**Power Supply:** 8-hour USB lithium ion battery is standard. However, it will also work with most USB batteries. The F<sub>V</sub>/F<sub>M</sub> meter also works with mains current. It comes with a universal Voltage and frequency USB charger. It also comes with a US plug. The size of the battery allows easy insertion into clothing pockets.

**Dimensions:** The meter is 9 in. long, USB cable from meter to battery is 36 in. long, Protective transport case is 14"x 11"x 6"

**Weight:** F<sub>V</sub>/F<sub>M</sub> meter w/bat. & USB cable are 12.8 oz. Meter with transport case and accessories weigh 3.65 lbs.

**Operating temperature range:** 0°C to 50°C

**Dark adaption clips:** 10 supplied with F<sub>V</sub>/F<sub>M</sub> meter .