

Chlorophyll Concentration Meter | MC-100 *Patented*

Measure chlorophyll not SPAD.

Linear Output

The Apogee chlorophyll concentration meter is calibrated to measure chlorophyll concentration in leaves with units of μmol of chlorophyll per m^2 . This eliminates the problems with relative indexes of chlorophyll, like the SPAD index, which is not linearly related to chlorophyll concentration.

For reference and comparison purposes, the Apogee meter also outputs relative units [CCI or SPAD] if desired. For details see: Parry, C., Blonquist Jr., J.M., & Bugbee, B. 2014. *In situ measurement of leaf chlorophyll concentration: analysis of the optical/absolute relationship. Plant, Cell and Environment* 37:2508-2502.

Non-destructive Measurement

The meter measures the ratio of radiation transmittance from two wavelengths (red, strongly absorbed by chlorophyll, and near infrared, not absorbed by chlorophyll), making measurements non-destructive and nearly instantaneous (measurement time is less than 3 seconds). This facilitates rapid measurement of multiple leaves and monitoring of the same leaves over time.

Storage Capacity and Geo-referencing

Memory allocated to data storage allows for 160,000 logged measurements. A mini USB port allows for direct connection to a computer to download data. An RS-232 port is available for external GPS connection, allowing field data to be geo-referenced. Storage capacity of geo-referenced data is 94,000 measurements.

Typical Applications

Applications include: chlorophyll concentration determination in plant leaves for assessment of nutrient status, fertilizer requirements, evaluation of stress, and optimization of harvest.



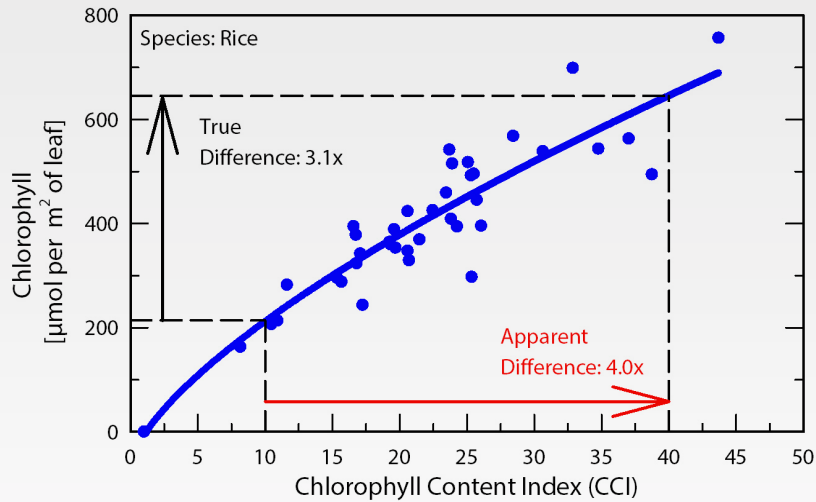
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apogee
INSTRUMENTS
Logan, UT

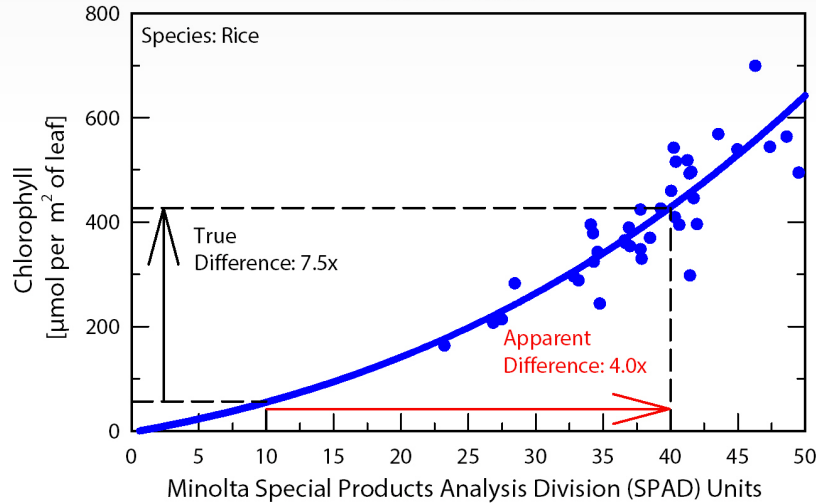
Chlorophyll meters typically output an index that is non-linearly related to chlorophyll concentration (e.g., CCI or SPAD). The MC-100 outputs an estimate of actual chlorophyll concentration in units of μmol per m^2 of leaf surface, thus, changes in the displayed output are true changes in chlorophyll concentration. For example, a doubling of measured chlorophyll concentration represents an actual doubling in a plant leaf, whereas a doubling of a relative index does not necessarily represent a doubling of actual chlorophyll concentration in the leaf. This concept is illustrated for CCI and SPAD index measurements on rice leaves in the graphs below.

Parry, C, Blonquist Jr., J.M. & Bugbee, B. 2014. In situ measurement of leaf chlorophyll concentration: analysis of the optical/absolute relationship. *Plant and Cell Environment* 37:2508-2520.

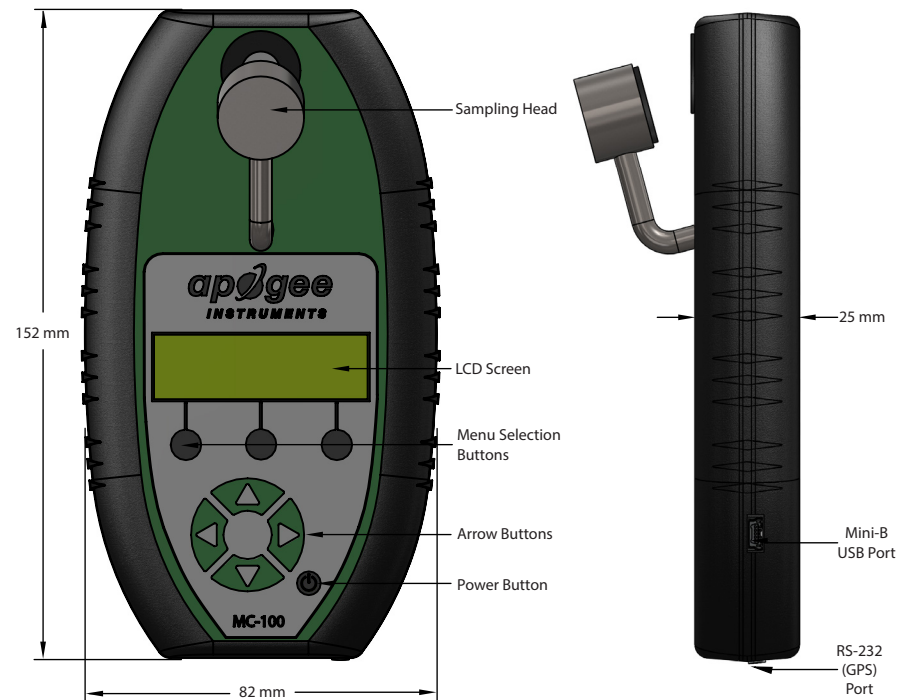
CCI Units



SPAD Units



Diagram



MC-100

Default Display Unit	μmol of chlorophyll per m^2 of leaf surface
Optional Display Units	CCI, SPAD
Measurement Area	63.6 mm^2 (9.0 mm standard diameter), 19.6 mm^2 (5.0 mm diameter with reducer)
Resolution	$\pm 10 \mu\text{mol m}^{-2}$ chlorophyll concentration for generic equation (less for specific species), 0.1 Chlorophyll Content Index (CCI) unit
Linearity	$\pm 1 \%$
Repeatability	$\pm 1 \%$
Sample Acquisition Time	Less than 3 s
Storage Capacity	8 MB for up to 160,000 data measurements; 94,000 data measurements with GPS data entries
User Interface	50 mm by 15 mm graphic display screen; 8 push buttons for control and data manipulation
Data Output	Mini-B USB port provided for main data transfer; RS-232 port can be used with GPS for integrated measurement
Measured Variables	Ratio of optical transmission at 931 nm to optical transmission at 653 nm
External GPS Option	RS-232 port (GPS location data is saved with each measurement)
Operating Temperature	0 to 50 C
Temperature Drift	Temperature compensated source and detector circuitry over full range
Power Requirement	Standard 9 V DC alkaline battery
Auto-off Interval	4 minutes (with no key press or download)
Dimensions	152 mm length, 82 mm width, 25 mm height
Mass	210 g
Warranty	1 year against defects in materials and workmanship
Patent	US 9,733,179