

Help Center

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What does the MultispeQ measure?

The standard MultispeQ protocol measures the following parameters*:

Parameter	What does it mean?
Primary Parameters	
Ambient Humidity	Relative humidity in percent (%)
Ambient Pressure	Atmospheric pressure (mbar) - This value is not corrected to sea level as found in weather reports
Ambient Temperature	Ambient temperature in degree Celsius (°C)
ECSt mAU	Total magnitude of ECS (electrochromic shift) decay during a light-dark transition (DIRK measurement) expressed in milli-absorbance unit. <i>Sacksteder et al. Proc. Nat. Acad. Sci. (2000)</i> (https://www.pnas.org/content/97/26/14283), <i>Kramer et al. Photosynthesis Res. (1999)</i> (https://doi.org/10.1023/A:1006212014787)
gH+	Steady-state rate of proton flux through the chloroplast ATP synthase. <i>Kanazawa and Kramer, Proc. Nat. Acad. Sci. (2002)</i> (https://www.pnas.org/content/99/20/12789#)
Leaf Angle	The angle of the leaf, from 0 - 90 degrees
Leaf Temperature Differential	Leaf Temperature (or contactless_temp) minus Ambient Temperature , negative numbers mean that the leaf is cooler than the surrounding air and vice versa.
LEF	Linear Electron Flow. The total flow of electrons from antennae complexes (where light is captured) into Photosystem II, taking the leaf absorptivity into account. Calculated as $LEF = \Phi_2 \times PAR \times 0.45$
Light Intensity (PAR)	Photosynthetically active radiation. Fraction of the incoming light (400 nm to 700 nm) which can be utilized to drive photosynthesis; $\mu\text{mol photons} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$
NPQt	Estimate of non-photochemical quenching. The amount of incoming light that is regulated away from photosynthetic processes in order to reduce damage to the plant.

Parameter	What does it mean?
Phi2	Quantum yield of Photosystem II. This measurement is essentially the percentage of incoming light (excited electrons) that go into Photosystem II. Photosystem II is where most light energy is converted into food.
PhiNO	Ratio of incoming light that is lost via non-regulated processes. PhiNO is the combination of a number of unregulated processes whose by-products can inhibit photosynthesis or be harmful to the plant. <i>Kuhlgert et al. Royal Soc Open Sci. (2016) (https://dx.doi.org/10.1098/rsos.160592)</i>
PhiNPQ	Ratio of incoming light that goes towards non-photochemical quenching. The plant regulating excess energy in such a way as too reduce damage to the plant. <i>Kuhlgert et al. Royal Soc Open Sci. (2016) (https://dx.doi.org/10.1098/rsos.160592)</i>
PS1 Active Centers	Active Photosystem I that is operational to receive/pass electrons. <i>Kanazawa et al. Front. Plant Sci. (2017) (https://dx.doi.org/10.3389/fpls.2017.00719)</i>
PS1 Open Centers	Photosystem I that is ready to accept electrons. <i>Kanazawa et al. Front. Plant Sci. (2017) (https://dx.doi.org/10.3389/fpls.2017.00719)</i>
PS1 Over Reduced Centers	All the acceptor side of Photosystem I are occupied by electrons and cannot accept any more electrons. <i>Kanazawa et al. Front. Plant Sci. (2017) (https://dx.doi.org/10.3389/fpls.2017.00719)</i>
PS1 Oxidized Centers	One or all of the acceptors of Photosystem I have no electron(s). <i>Kanazawa et al. Front. Plant Sci. (2017) (https://dx.doi.org/10.3389/fpls.2017.00719)</i>
Relative Chlorophyll	Otherwise known has "SPAD" (Special Products Analysis Division), relative chlorophyll is a measure of leaf "greenness". This measurement is often correlated with leaf nitrogen levels
Thickness	The thickness of the leaf as measured by the Hall Effect sensor embedded in the MultispeQ clamp.
vH+	Proton conductivity of the chloroplast ATP synthase. <i>Avenson et al. Plant Cell Environ. (2005) (https://dx.doi.org/10.1111/j.1365-3040.2005.01294.x)</i>
Advanced	
absorbance_wavelength	The absorbance of light from each wavelength that passed through the leaf
angle_direction	Abbreviated cardinal direction (e.g. NW - North West)
B	The raw amount of blue light captured by the PAR sensor
compass	Cardinal direction in degrees from North

Parameter	What does it mean?
compass_direction	Abbreviated cardinal direction (e.g. NW - North West)
contactless_temp	Surface temperature in degree Celsius (°C)
ECS_tau	The rate of ECS. This indicates the lifetime of steady-state proton translocation through the chloroplast ATP synthase. <i>Sacksteder et al. Proc. Nat. Acad. Sci. (2000)</i> (https://www.pnas.org/content/97/26/14283), <i>Kramer et al. Photosynthesis Res. (1999)</i> (https://doi.org/10.1023/A:1006212014787)
FmPrime	Maximum variable fluorescence at steady-state conditions
FoPrime	Minimum variable fluorescence during dark phase after steady-state
Fs	Variable fluorescence at steady-state conditions
G	The raw amount of green light captured by the PAR sensor
kP700	The rate constant of P700 electron transfer. P700 is the primary electron acceptor of PS1.
P700_DIRK_ampl	The amplitude of the P700 electron transfer in light-dark transition (DIRK measurement). It indicates the condition of PS1 electron transfer. <i>Kanazawa et al. Front. Plant Sci. (2017)</i> (https://dx.doi.org/10.3389/fpls.2017.00719)
pitch	Pitch is the angle the instrument is held along the short axis
qL	Fraction of Photosystem II centers which are in the open state
R	The raw amount of red light captured by the PAR sensor
roll	Roll is the angle the instrument is held along the long axis
tP700	"Tau" P700: the lifetime of P700 electron transfer. P700 is the primary electron acceptor of PS1.
V_initial_P700	The initial rate of P700 steady-state electron transfer.

**Some of the parameters are not available for the beta version of the MultispeQ*


Check out this Talk of what the MultispeQ measures by Dr. Kramer


David Kramer explains what the MultispeQ measures





Where can I find more information?


You can search <https://pubmed.com> (<https://pubmed.com>) or <https://scholar.google.com> (<https://scholar.google.com>) if you are looking for scientific literature. Below you find a small selection of literature that will get you started:


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