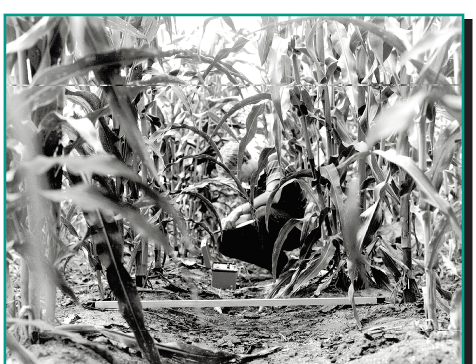
LI-191SA Line Quantum Sensor

Measure Photosynthetically Active Radiation in Plant Canopies

During photosynthesis, plants use energy in the region of the electromagnetic spectrum from 400-700 nm (1, 2). The radiation in this range, referred to as Photosynthetically Active Radiation (PAR), can be measured in energy units (watts m^{-2}) or as Photosynthetic Photon Flux Density (PPFD) which has units of quanta (photons) per unit time per unit surface area. The scaled units most commonly used are micromoles of quanta per second per square meter (µmol s^{-1} m^{-2}).

Measuring PAR within a plant canopy can be very difficult because of the non-uniformity of the light field. When PAR is measured with a small diameter quantum sensor such as the LI-190SA Quantum Sensor, intensity can vary 10-fold between sunflecks and shadows, requiring a large number of readings to get an accurate average. The LI-191SA Line quantum Sensor reduces the number of individual readings required because it effectively averages PPFD over its one meter length. One person can quickly make plant canopy PPFD measurements in many plots in a short period of time.

Rather than using multiple detectors linearly arranged over its one meter length, the LI-191SA uses a 1 meter long quartz rod under a diffuser to conduct light to a single high quality quantum sensor whose response is shown in Figure 1. There are two advantages of this design. First, the sensor has a very good quantum response unlike sensors using inexpensive gallium arsenide detectors with only an approximation of the ideal quantum response. Second, the single quantum sensor is much easier to keep in calibration than multiple (up to 80) individual gallium arsenide detectors.



The LI-191SA Line Quantum Sensor spatially averages PPFD over its one meter length.

Quantum Sensors

LI-COR Quantum Sensors are used to measure PPFD of photosynthetically active radiation (PAR). A simple integral relationship exists between the number of molecules photochemically changed and the number of photons absorbed within a particular waveband regardless of photon energy (3). The ideal quantum sensor should have an equal response to all photons within the 400-700 nm waveband. A typical response curve of a LI-COR quantum Sensor plotted against the ideal quantum response is shown in Figure 1.

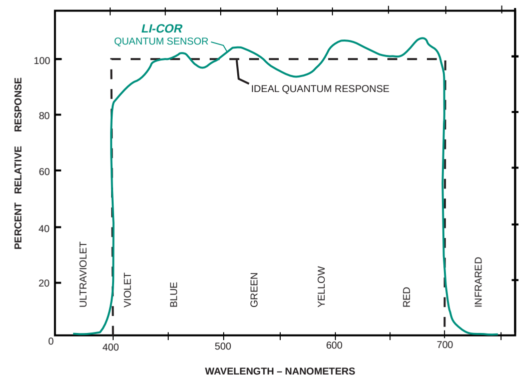


Figure 1. Typical spectral response of LI-COR Quantum Sensors vs. Wavelength and the Ideal Quantum Response (equal response to all photons in the 400-700 nm waveband).

LI-191SA Specifications

Absolute Calibration: ± 10% traceable to NIST. The LI-191SA is calibrated via transfer calibration from a LI-COR reference Quantum Sensor.

Sensitivity: Typically 7 µA per 1000 µmol s^{-1} m^{-2}.

Linearity: Maximum deviation of 1% up to 10,000 µmol s^{-1} m^{-2}.

Stability: < ± 2% change over a 1 year period.

Response Time: 10 µs.

Temperature Dependence: ± 0.15% per °C maximum.

Cosine Correction: Acrylic diffuser.

Azimuth: < ± 2% error over 360° at 45° elevation.

Sensitivity Variation over Length: ± 7% maximum using a 1” wide beam from an incandescent light source.

Sensing Area: 1 meter L × 12.7 mm W (39.4” × 0.50”).

Detector: High stability silicon photovoltaic detector (blue enhanced).

Sensor Housing: Weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware.

Size: 116 L × 2.54 W × 2.54 cm D (45.5” × 1.0” × 1.0”).

Weight: 1.8 kg (4.0 lbs.).

Cable Length: 3.1 m (10.0 ft.).

Ordering Information

The LI-191SA Line Quantum Sensor comes with a bubble level, detachable 10 ft. cable and hardsided carrying case. The cable is terminated with a BNC connector and can be directly connected to a readout device such as the LI-250 Light Meter, LI-1400 DataLogger or to the 2290 Millivolt Adapter for connecting to readout devices requiring a millivolt signal. Other accessories are described on the Accessory Sheet.

LI-191SA Quantum Sensor
2290 Millivolt Adapter
2222SB-50 Extension Cable
2222SB-100 Extension Cable

REFERENCES

1. Federer, C.A. and C.B. Tanner. 1966. Sensors for measuring light available for photosynthesis. Ecology 47:654-657.

2. McCree, K.J. 1972. Test of current definitions of photosynthetically active radiation against leaf photosynthesis data. Agric. Meteorol. 10:443-453.

3. Rabinowitch, E.E. 1951. Photosynthesis and related processes. Inter-science. New York. 2088 pages.

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