ACLIMAS training courses
Advanced tools to predict water stress and its effect on yield
Hammamet (Tunisia) – 24-27/11/2014

ECOPHYSIOLOGY and AGROMETEOROLOGY

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LABORATORY AND FIELD EQUIPMENT

Line quantum Sensor LI-191 LICOR

During photosynthesis, plants use energy in the region of the electromagnetic spectrum from 400-700 nm. The radiation in this range, referred to as Photosynthetically Active Radiation (PAR), is typically measured as Photosynthetic Photon Flux Density (PPFD), which has units of quanta (photons) per unit time per unit surface area. The units most commonly used are micromoles of quanta per second per square meter (µmol s^{-1} m^{-2}). Plant scientists, horticulturists, ecologists, and other environmental scientists use LI-COR's Quantum Sensors to accurately measure this variable.

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Datalogger LI-1000 LI-COR

The LI-191 is supported by a friendly datalogger named LI-1000 LI-COR which is used to read and store data. Afterwards, this data is sent to the user's computer for further processing.

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LI-6400 LI-COR PHOTOSYNTHESIS ANALYZER

The LI-6400 is a portable photosynthesis system equipped with two dual-channel infrared analyzers for the measurement of differential CO2 and H2O, housed directly in the sensor head.

This allows you to make very rapid measures without waiting for any balancing of flows.

Is able to perform simultaneously the measures of photosynthesis and fluorescence, on the same leaf. In a few seconds, on the display, in real time, we can understand what is happening at that moment, at to the leaf taken into consideration, such as whether the plant is in stress or not, the leaf temperature, having also mounted in the sensor head, a temperature sensor, the humidity, the stomatal conductance and many other parameters. If the data is to our liking, we can just save them on the console, and then download them to your computer for further processing.

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SENSOR HEAD

ADDITIONAL LIGHT SOURCE

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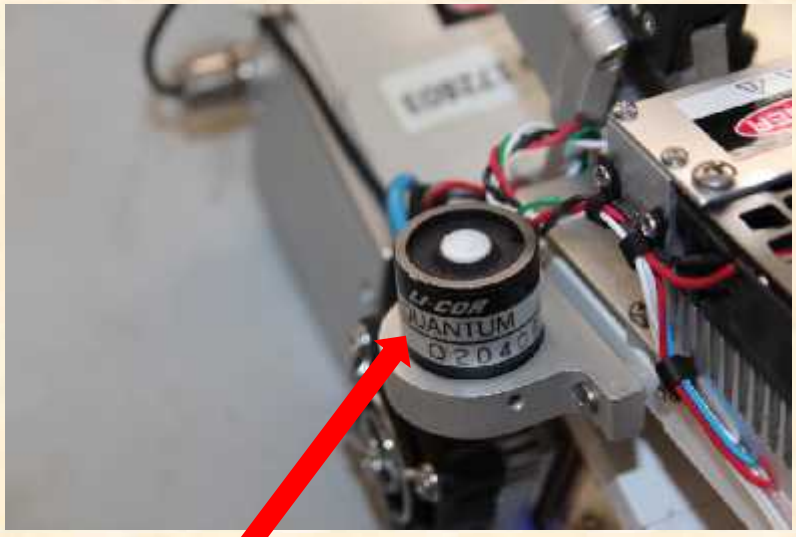
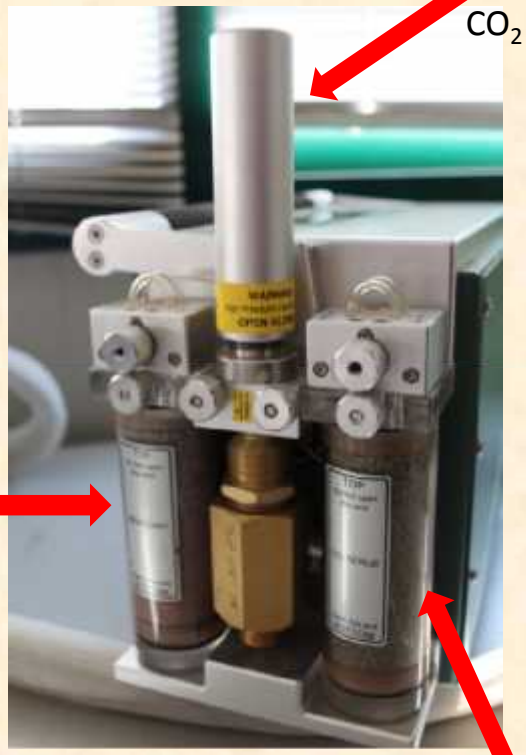


P.A.R. sensor

drierite



CO_2 tank container

soda lime

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L.A.I. (Leaf Area Index) LI-3100C LI-COR

The LI-3100C Area Meter LI-COR is fast and simple to use and provides very precise measurements of large and small objects.

In our case, the leaves can be easily measured in, by inserting the same leaves between the two transparent ribbons.

An adjustable pressure roller smoothes curly leaves to run them properly between the transparent ribbons. The thickness of the material measured can reach 25 mm. The leaf area can be read progressively, cm^2, as it accumulates on the instrument display. The LI-3100 data can be stored and exported through a serial port and a USB; the software interface is in a Windows environment.

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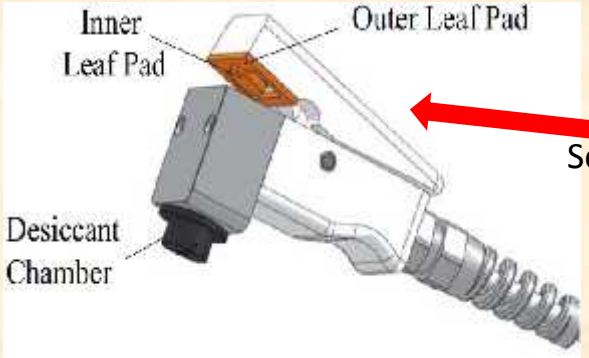
Leaf porometer SC-1 Decagon

The Leaf Porometer is a battery-operated, menu-driven device that measures leaf stomatal conductance. Stomatal conductance is a function of the density, size, and degree of opening of stomata, which are pores in plants that open to the outside air. The Leaf Porometer measures stomatal conductance by putting the conductance of a leaf in series with two known conductance elements, and comparing the humidity measurements between them. It can display information in three selectable units:

1. mmol/m^2s (millimoles per meter squared seconds)
2. m^2s/mol (meters squared seconds per mole)
3. s/m (seconds per meter).

The Leaf Porometer cannot take measurements without the aid of the sensor head.
This sensor head is responsible for gathering the information (vapor pressure, humidity, etc.) that the Leaf Porometer uses to calculate stomatal conductance .



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WEATHER STATION

The Mediterranean Agronomic Institute of Bari (MAI-B) boasts a respectable weather station that was modernized a few months ago, in accordance with the WMO (World Meteorological Organization) parameters to guarantee the high reliability of the data recorded.

MAI-B WEATHER STATION

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The data recorded on an hourly and on a daily basis are stored in the datalogger CR1000 Campbell and sent remotely through a wireless connection and through the interface module NL240 Campbell. Data can be processed by downloading it, if necessary, with a dedicated program, i.e. the LoggerNet. The whole system is powered by a solar panel equipped with a charge controller and an additional battery. All packed in a sealed box.

Solar panel

Interface module NL240

Charge controller
Solar panel

Additional battery

Sealed box

Datalogger CR1000
Campbell

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Our station is equipped with the WMO (World Meteorological Organization) standard tools. Air temperature (°C) and relative humidity (%), are measured by means of a thermo-hygrometer having a ventilated screen. Air temperature and relative humidity are measured at two different heights, that is at 2 meters and 10 meters, according to the WMO standards.

Thermo-Hygrometer at 2 meters

Thermo-Hygrometer at 10 meters

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The wind speed is measured by a cup anemometer in m/s whereas the wind direction is measured by a weather vane, the output is given in angular degrees.

Both wind speed and direction are also measured at 10 meters high, according to the WMO standards.

Anemometer at 10 meters

Anemometer at 2 meters

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The albedometer *kipp & zonen* measures the direct solar radiation through the upper spherical cap and the reflected solar radiation through the lower cap. Units is W/m^2 (W/m^2 *0.0864 = MJ/m^2day).

Precipitation is measured in mm by means of a rain gauge, that has a collection surface of 1000 sq. cm. (Unlike other rain gauges that have smaller surfaces such as 314 sq. cm. or 500 sq.cm.)

Albedometer Kipp&Zonen

Rain Gauge

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The Atmometer is an interesting tool. It is a scientific instrument used for measuring the rate of water evaporation from a wet surface to the atmosphere. Atmometers are mainly used to measure evapotranspiration (ET). The Evapotranspiration is the measure of all of the water that evaporates from land surfaces plus the water that transpires from plant surfaces.

An atmometer consists of a porous, ceramic plate connected to a water reservoir by a glass or plastic tube. Water is drawn from the water reservoir through the tube to wet the plate. As the water on the plate evaporates, more water is drawn from the reservoir to re-wet the plate. A canvas cover made of Gore-Tex is placed over the plate to prevent anything from getting in. The canvas cover is important because it simulates the amount of solar radiation a plant absorbs under certain weather conditions and controls the rate of evaporation. Different types of canvas covers simulate different amounts of evapotranspiration rates that various plant surfaces would undergo. A membrane between the plate and canvas cover prevents rain water from wetting the gauge, yet it allows water vapor to escape. A gauge that runs up the side of the atmometer measures the level of water in the reservoir, which shows how much water has evaporated.

Atmometer

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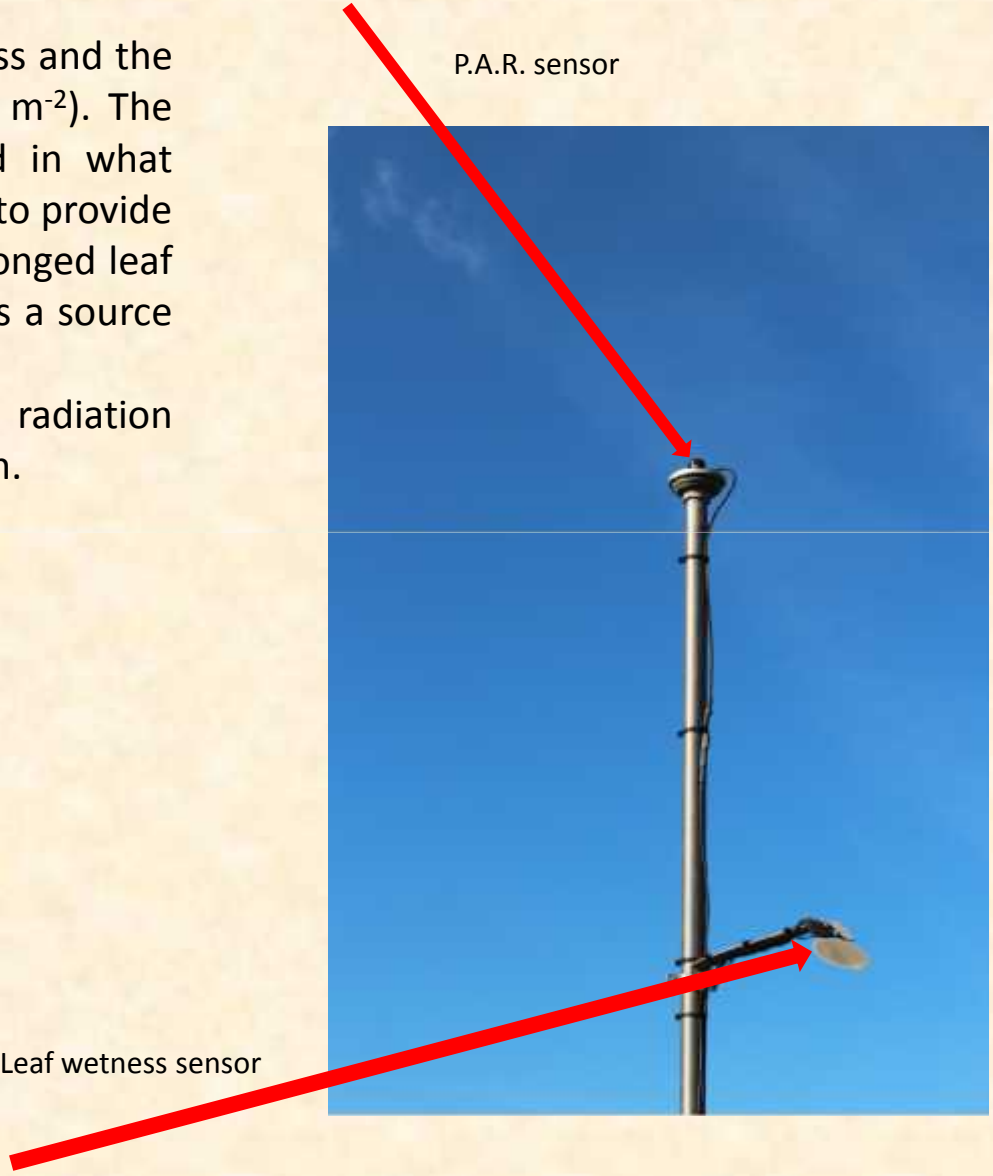
Two additional important parameters are leaf wetness and the P.A.R. (Photosynthetically Active Radiation µmol s^{-1} m^{-2}). The first one is used to determine for how long and in what quantity the leaf remains wet and it is indispensable to provide researchers with data concerning excessive and prolonged leaf moisture which, associated with other parameters, is a source of disease.

The P.A.R. measures the photosynthetically active radiation which approximately equals 50% of the total radiation.



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Finally the weather station is also equipped with a shelter where mechanical instruments are placed. These mechanical instruments are used to compare and/or replace data in the event of failure of the automatic station and they also serve as demonstration to our students. The main instruments are the following: a Thermo-hygrograph, which is used to measure temperature and relative humidity of air; a Pluviograph, used to measure the amount of precipitation; an Anemograph, which is used to measure wind speed and wind direction; and a CLASS A evaporation pan, standard size (1220 mm diameter and 254 mm height). The device is positioned generally in a meadow of grass, on a wooden stand 10 cm above the ground. The tank contains water, with the free surface maintained at 50-75 mm from the edge, it is provided with a stilling well in which it detects daily lowering the level by means of a micrometer screw or an electric sensor, which is used indirectly to calculate water evaporation by making the difference between the previous and the following reading.

Weather shelter

Class A Pan

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