Dataset of photosynthesis and photosynthetic factors measurements of greenhouse tomato

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A R T I C L E   I N F O

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A B S T R A C T

This article presents a set of photosynthetic responses and related environmental variables from greenhouse tomato plants (Lycopersicum esculentum). The dataset was obtained by direct in situ measurement of functional leaves of 100 different plants with a portable photosynthesis system. The measurements were taken for six hours at different time intervals in 16 different days during the cycle of November 2019 to January 2020. This dataset can be used to understand the physiology of greenhouse tomato plants and for the design of photosynthesis forecasting models. It is also useful in precision agriculture and for designing automatic controllers for optimal temperature, humidity, and CO₂ enrichment, with the purpose of maximizing productivity and avoiding waste of resources. Additionally, this dataset can be used for research in time series analysis.

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Specifications Table

| Subject                          | Agronomy and Crop Science |
|---------------------------------|---------------------------|
| Specific subject area           | Plant physiology, Photosynthesis |
| Type of data                    | Table                     |
| How data were acquired          | Direct non-destructive leaf measurement with a LI-6400XT Portable Photosynthesis System and OPEN software version 6.2 |
| Data format                     | Raw                       |
| Parameters for data collection  | On the field measurements following equipment manufacturer preparation checklist and operating instructions [1]. |
| Description of data collection  | In situ leaf enclosed in chamber for measurement of CO₂ exchange in differential mode. |
| Data source location            | City/Region: Villa de Cos/Zacatecas |
|                                 | Latitude and longitude for collected samples/data: 230 14’ 02” N and 1020 21’ 2” W, 1944 mamsl. |
| Data accessibility              | Repository name: Mendeley Data |
|                                 | Data identification number: 10.17632/28zbsynrfm.1 |
|                                 | Direct URL to data: https://data.mendeley.com/datasets/28zbsynrfm/1 |

Value of the Data

- This dataset can be used to understand the physiology of greenhouse tomato plants. It has values for the climatic and physiological elements involved with the photosynthesis process.
- This dataset is useful for engineers and producers interested in precision agriculture and in the design of automatic controllers.
- The dataset could serve as a sample of the characterization of a natural process for plant bioengineering and synthetic biology.
- Furthermore, these data can be used for the derivation of photosynthesis forecasting models and as a dataset for time series analysis.

1. Data Description

The portable photosynthesis meter produces values for the photosynthetic factors and the physiological variables of the leaves related with the photosynthesis process [2–4], such as the responses of plants to stomatal conductance, reference water in the cell, relative humidity in the cell, transpiration rate, atmospheric pressure, different temperatures in cell space and on plant surfaces.

These measures are provided in data tables separated in two folders:

- 100-1 min – contains files for 100 measures taken in 2 modules, approximately every 1 min, for a total of 200 each day.
- 50–15 min – contains files for 50 daily measures, taken between 5 and 15 minutes approximately.

Each folder contains several excel files with the name PhotoXM_date.xls, where X is the number of measures taken and date is the corresponding day. Each file has a table, where every row is a measure with 56 columns [1]. Their names and corresponding description are in Table 1.

2. Experimental Design, Materials and Methods

The researched crop is greenhouse tomato (Lycopersicum esculentum). It was grown in a hydroponic system of coconut substrate in bags of 90 cm long and 28 l with 3 plants each, with
Table 1
Data values.

| Value            | Description                                                                 |
|------------------|------------------------------------------------------------------------------|
| Obs              | # Obs stored in log file                                                     |
| HHMMSS           | Real Time Clock                                                              |
| FTime            | Time since logging started                                                  |
| EBal?            | Do energy Balance?                                                           |
| Photo            | Photosynthetic rate                                                          |
| Cond             | Conductance to H₂O                                                          |
| Ci               | Intercellular CO₂ concentration                                              |
| Trmmol           | Transpiration rate                                                           |
| VpDL             | Vapor pressure deficit based on Leaf temp                                    |
| CTLeaf           | Computed leaf temp (°C). Same as Tleaf C unless doing energy balance         |
| Area             | In-chamber leaf Area                                                         |
| BLC_1            | Not used by this version (Version 6)                                         |
| StmRat           | Stomatal Ratio estimate                                                      |
| BLCond           | Not used by this version (Version 6)                                         |
| Tair             | Temperature in sample cell                                                   |
| Tleaf            | Temperature of the leaf thermocouple                                         |
| TBlk             | Temperature of cooler block                                                  |
| CO2R             | Reference Cell CO₂                                                           |
| CO2S             | Sample Cell CO₂                                                              |
| H2OR             | Reference Cell H₂O                                                           |
| H2OS             | Sample Cell H₂O                                                              |
| RH_R             | Relative Humidity in the reference cell                                      |
| RH_S             | Relative Humidity in the sample cell                                         |
| Flow             | Flow rate to the sample cell                                                 |
| PARi             | In-Chamber quantum sensor                                                    |
| PARo             | External quantum sensor                                                      |
| Press            | Atmospheric Pressure                                                         |
| CsMch            | Sample CO₂ offset umol/mol                                                    |
| HsMch            | Sample H₂O offset umol/mol                                                    |
| StableF          | Stability status as a decimal value                                          |
| BLCslope         | Slope as function of area                                                    |
| BLCoffst         | Offset as function of area                                                    |
| f_parin          | Fraction of Parin_um to use for EB                                           |
| f_parout         | Fraction of Parout_um to use for EB                                          |
| alphaK           | Adsorption factor alpha∗conversion factor k                                  |
| Status           | Numerical status code                                                        |
| fda              | flow / area with unit conversion                                             |
| Trans            | Transpiration                                                                |
| Tair_K           | Chamber Air Temperature                                                      |
| Twall_K          | Wall Temperature                                                              |
| R(W/m2)          | Incoming Radiation                                                           |
| Tl-Ta             | Energy Balance Delta T                                                       |
| SVTleaf           | SatVap(Tleaf)                                                                |
| h2o_i            | Intercellular H₂O                                                            |
| h2o2diff         | Diff                                                                          |
| CTair            | Air Temperature in the leaf chamber                                          |
| SVTair           | SatVap(air)                                                                  |
| CndTotal         | Total Conductance                                                            |
| vp_kPa            | Vapor pressure chamber air                                                   |
| VpdA             | Vapor pressure deficit based on Air Temp                                      |
| CndCO2           | Total Conductance to CO₂                                                     |
| Ci_Pa            | Intercellular CO₂                                                            |
| Ci/Ca            | Intercellular CO₂/Ambient CO₂                                                |
| RHsfc            | Surface Humidity                                                             |
| C2sfc            | Surface CO₂                                                                  |
| AHs/CS           | Ball-Berry Parameter                                                         |
a density of 2.6 plants/m². The Steiner nutrient solution that was used in the emitter of the drip irrigation system, had an electrical conductivity of 2.5 dS m⁻¹. The greenhouse structure has 50 m long, 10 m width and 5 m height with a north-south orientation in the direction of the gutters.

The dataset was obtained in 16 different days in the cycle of November 2019 to January 2020, by direct non-destructive measuring of carbon dioxide exchange of a functional leaf. The measures were obtained with a portable photosynthesis system LI-6400XT with OPEN software version 6.2 [1]. During the experiment, the air flow was constant at 400 μmol s⁻¹ and the CO₂ supply at 400 ppm. The temperature of the device chamber was not maintained constant. The values for the photosynthetic rate, intercellular CO₂ concentration, photosynthetically active radiation (PAR) and, temperature of the leaf were obtained in 2 different sets: the first one contains measurements taken approximately every minute from 100 plants in two modules, for a total of 200 measurements each day. The second set is for measurements taken every 5–15 min from about 50 plants.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi: 10.1016/j.dib.2020.106274.

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