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Data Descriptor

Growth Analysis and Nutrient Solution Management of a Soil-Less Tomato Crop in a Mediterranean Environment

Angelo Signore [1,*], Francesco Serio [2] and Pietro Santamaria [1]

[1] Department of Agricultural and Environmental Science – University of Bari Aldo Moro, Via Amendola, 165/A – 70126 Bari, Italy
[2] Institute of Sciences of Food Production, CNR – National Research Council of Italy, Via Amendola, 122/O – 70126 Bari, Italy
Correspondence: angelo.signore@uniba.it; Tel.: +39-080-5443094

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Abstract: The data contained in this article are strictly related to our previous article titled "A Targeted Management of the Nutrient Solution in a Soilless Tomato Crop According to Plant Needs" (Signore, A. et al. 2016). The detailed datasets regards the amount of dry matter (Table 1), the nutrient solution consumption (Table 2) and the mineral composition of plant tissues (Tables 3–7) in a soil-less tomato crop. The information contained in this article are necessary since, unlike the northern European countries, such data are generally missing for the crops in the Mediterranean environment. By correlating the parameters reported above, we were able to provide a more precise management of the nutrient solution, by providing the correct nutrient concentration into the nutrient solution in function of (i) the volume of water absorbed, (ii) the growth rate and (iii) the nutrient concentration in tomato plant. Finally, the more precise management of the nutrient solution allowed discharging a lesser amount of water and nutrients into the environment, improving the sustainability of the crop.

Dataset: Growth analysis and nutrient solution management of a soil-less tomato crop in a Mediterranean environment, DOI: 10.17632/cyjcvt37gx.1, Angelo Signore, Mendeley Data, https://data.mendeley.com/datasets/cyjcvt37gx/1.

Keywords: water use efficiency; nutrient use efficiency; soilless; closed system; environmental sustainability

1. Summary

The management of soil-less tomato crop in a Mediterranean environment is often lacking information regarding the actual needs of the plants with respect to the mineral composition of plants and of the nutrient solution (NS) provided. Moreover, the water available in the coastal zone of the Mediterranean is often brackish and thus its use for vegetable cultivation has to be carefully considered [1,2]. However, soil-less systems allow the use of brackish water without problems for the soil [3] and, at the same time, may contribute to improve the quality of the tomato berries [4].

For punctual management of a tomato crop in the Mediterranean environment, we have considered the actual mineral composition of several organs (fruits, stems, leaves and roots) of a tomato plant, subdivided by the different phenological phases. The mineral composition of the plant was related to the nutrient concentration of the NS, the amount of water transpired, and the dry matter of the crop, weighted according to the different organs. Such data allowed us to calculate the transpiration/biomass ratio, namely the daily amount of water required to produce the unit of dry matter calculated as CGR [5], and to relate such a ratio to the mineral composition of the plant during the several phenological phases of the tomato crop. The composition of the nutrient solution may thus reflect that of the plant in a certain phase (flowering, harvesting, etc.), avoiding deficiencies of nutrients or luxury consumption and reducing the environmental impact of the crop. The datasets that we provide contain useful information regarding the management of a tomato crop in the Mediterranean environment, since they report the raw values that we collected to determine the transpiration/biomass ratio, and to relate such a ratio to the mineral composition of the plant on a daily basis.

2. Data Description

The datasets contain raw data regarding the following parameters of a soil-less tomato crop: dry matter production, NS consumption, cations concentration and total nitrogen content of leaves, stems, fruits, and roots. The datasets of the cations, for every organ, are subdivided according to their origin, namely, deriving from destructive sampling or from other activities (i.e., leaves from pruning or fruits from harvest). The data were minimally treated to remove most of the calculations from spreadsheet cells. Hence, the final data reported into the datasets spreadsheet are the same, but without most of the formulae.

3. Methods

Tomato crop (cv Naomi, F1) was cultivated with a soil-less system (Nutrient Film Technique—NFT, a re-circulated closed system). Three levels of EC were set up (5, 7.5 and 10 $dS \cdot m^{-1}$), above which the nutrient solution was completely replaced with a fresh one.

The nutrient solution (NS) was supplied over the whole benches using pumps (one for every bench) submerged into tanks (one for every bench)—see Reference [1] for more information. The plant density was 3.3 $plants \cdot m^{-2}$. Every 2 days, every tank was refilled with fresh NS up to the initial volume. The NS consumption, due mainly to transpiration, because in a NFT system the evaporation is negligible, was referred to a single plant by dividing the volume of NS added to each tank by the plants number. In addition, the volume of NS discharged during the cycle and at the end of it was measured. The minimum value of temperature was set to 12 °C, while the ventilation temperature was 20 °C. The relative humidity was always higher than 50%, except for 2 days, in which it reached 45% (data not shown).

Fortnightly, one plant from each experimental area was removed, and the following parameters were measured: fresh and dry weight of leaves, stem, and roots; and number, fresh, and dry weight of fruits. A sample of every organ for treatment was taken in order to analyze the tissues for their mineral composition. For the calculation of the total biomass produced by the crop, the fruit harvested and leaves from pruning were also considered.

The NS data (namely, the transpiration of the crop) and CGR were interpolated over time to calculate the transpiration–biomass ratio, i.e. how many liters of nutrient solution were necessary to produce 1 kilogram of dry matter.

The datasets include observations related to:

- dry matter production of tomato, subdivided into the several organs (leaves, stems, fruits, and roots);
- nutrient solution consumption (L/plant);
- inorganic cations, subdivided for the several organs (leaves, stems, fruits, and roots);
- total nitrogen, subdivided for the several organs (leaves, stems, fruits, and roots).
- Ion chromatography (Dionex model DX500; Dionex Corporation, Sunnyvale, CA, USA), as reported by Reference [3], was used to determine the concentration of cations in the several organs of the plant. The total nitrogen was determined with the Kjeldahl method as reported by Reference [6]. The volume of the NS was measured by means of a flow

meter, and a forced-draft oven was used to determine the dry matter and a balance with two decimal places to weigh it. The crop was cultivated with a closed soil-less system (Nutrient Film Technique—NFT). The nutrient solution was replaced when its EC reached the limit set point in every treatment, namely 5, 7.5 and 10 $dS \cdot m^{-1}$.

4. Usage Notes

The NS consumption data and Crop Growth Rate (CGR) were interpolated over the time to calculate the transpiration–biomass ratio.

The CGR was calculated as follow:

$$\mathrm{CGR} = \frac{(W2 - W1)}{t2 - t1}$$

where, W2 and W1 were the dry weights of the plants at time t2 and t1, respectively.

Such data and the mineral composition of the plants, analyzed at each phenological stage and weighted for the several organs of the plant, were placed into a spreadsheet and allowed us to calculate, on a daily basis, the concentration of the elements into the NS in function of transpiration, and permitted us to reintegrate the water and nutrients uptake by plants.

Author Contributions: Substantial contributions to the conception or design of the work; drafting the work; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved, A.S..; Interpretation of data; revised the article critically; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved, F.S.; Substantial contributions to the conception or design of the work; analysis and interpretation of data; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved, P.S.

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