

PROXIMAL SENSING AND AUTOMATIC INFORMATION EXTRACTION FOR MONITORING THE ROLE OF BIOCHAR AS A BIOFERTILIZER FOR STRAWBERRIES



Ilaria Orlandella¹, Nicola Dilillo², Kyra Smith¹, Elena Belcore¹, Silvia Fiore¹, Tonia Tommasi³, Marco Piras¹, Renato Ferrero²

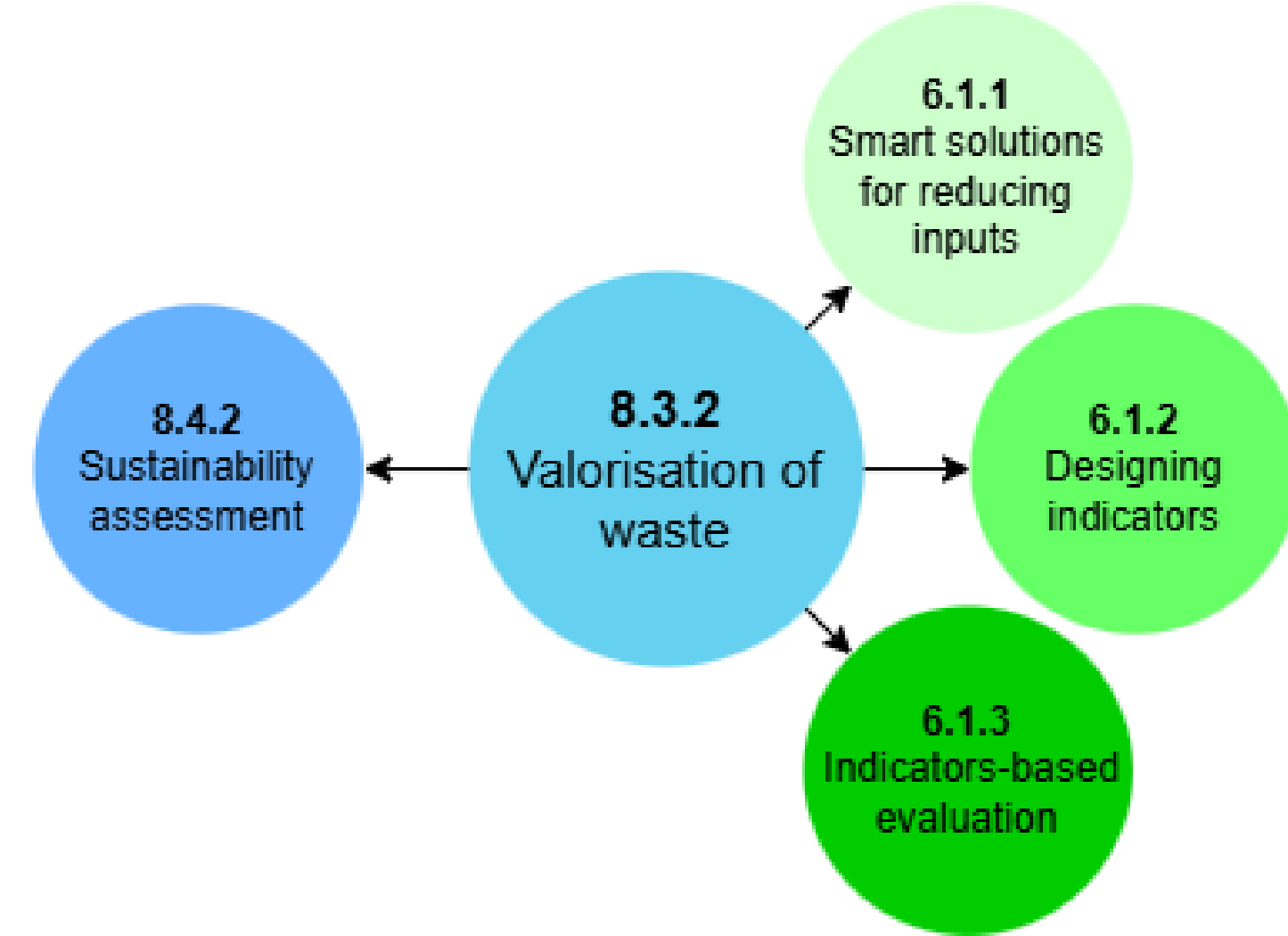
¹Department of Engineering for Environment, Land, and Infrastructures, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Turin, Italy
²Department of Control and Computer Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Turin, Italy
³Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Turin, Italy

E-mail: nome.cognome@polito.it

ABSTRACT

The project aims to evaluate and compare the effects of organic fertilizers (biochar and digestate) on greenhouse crops. The first trial focused on the effect of biochar produced from woody biomass on strawberry (*Fragaria × ananassa*) plants. Two groups of plants were treated with different doses of biochar. The plants were housed in a greenhouse equipped with multiple sensors which automatically gathered and stored data. Ground truth data was manually gathered twice weekly. Multispectral (MS) images were acquired and processed using a target-free calibration workflow, permitting the eventual calculation of plant health indices (NDVI) and automatic detection of plant fitness indicators. Eventually, a fully-automated proximal sensing and information extraction pipeline will allow for the convenient, up-to-date monitoring of greenhouse crops and comparison of organic fertilizers on plant health and productivity. Future trials will be carried out using digestate and the experiment will be extended to include other greenhouse crops.

TASK CONNECTIONS



MATERIALS

1 greenhouse 1 irrigation system 15 plants 15L soil 2 doses biochar
1 x proximal sensing system

SENSORS

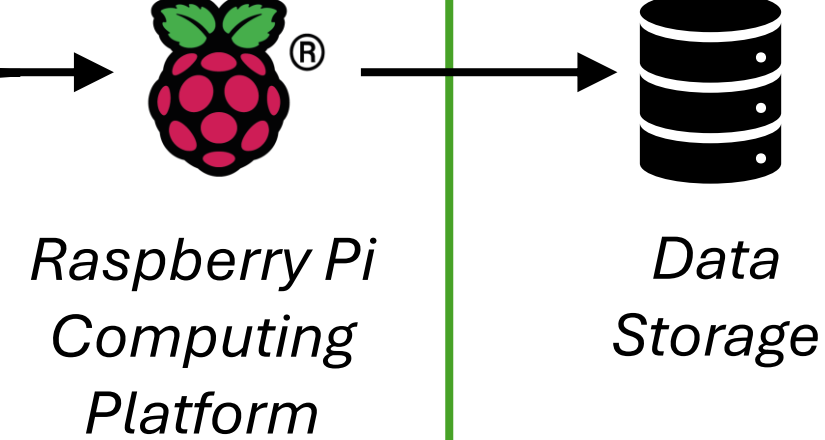
MAPIR Survey3W Camera
Low-cost MS Camera
HFOV: 87°
Bands: Red-Green-NIR (RGN)
Output: RAW + JPG



DHT22
Low-cost temperature + humidity sensor

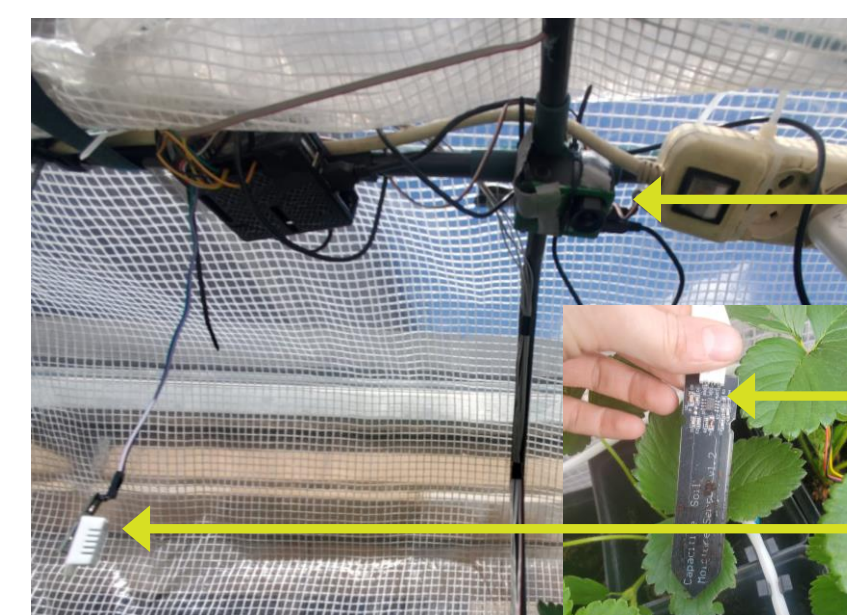


Capacitive Soil Moisture Sensor v1.2
Low-cost soil moisture sensor

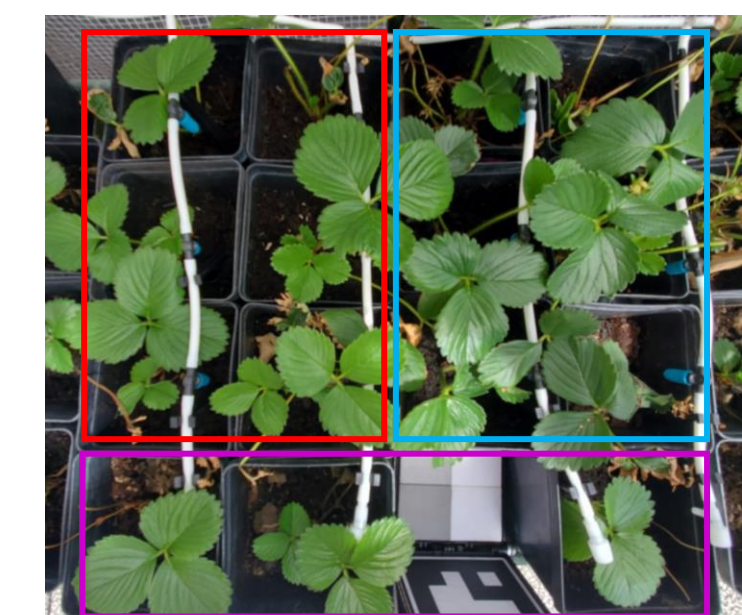


METHODS

1. Set-Up



2. Biochar Application



3. Data Collection

Data	Frequency
RGN images	Hourly
Air temperature (°C)	Every 10 minutes
Air humidity (%)	
Soil moisture (raw)	Start and End
Root length (cm)	
Plant height (cm)	Twice weekly
no. of flowers and fruits	

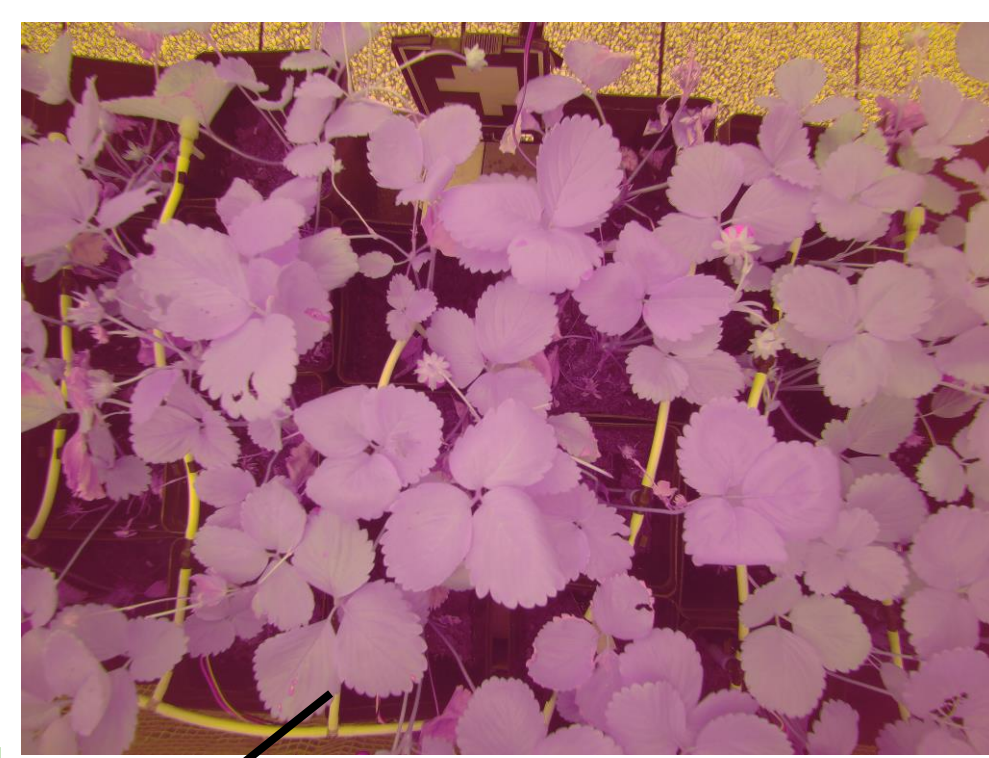
4. Data Analysis

- Radiometric calibration of images
- NDVI calculation
- Automatic flower and fruit detection and counting using deep learning model
- Correlation of biochar treatment with plant fitness indicators

RESULTS

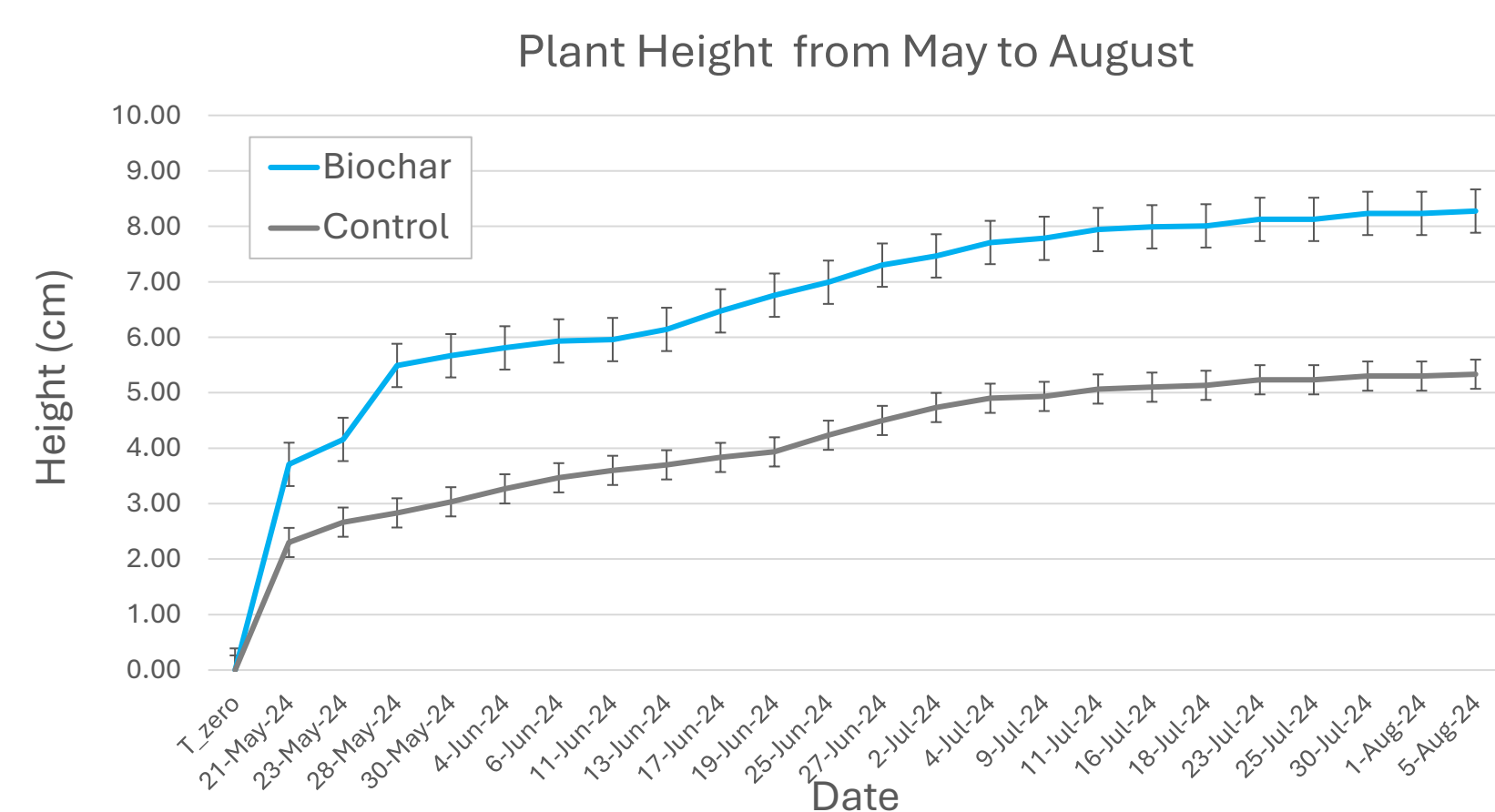
Automatic data collection and information extraction

Data	Quantity
RGN Images	2000+
Temperature + humidity	14591
Plant height (cm)	18
no. of flowers and fruits	



Next
NDVI calculation
+
Flower and fruit detection and counting

Effect of biochar on strawberry plants



Compared to untreated plants, biochar-treated plants:

- Grew taller
- Flowered earlier and longer
- Did not produce significantly more fruits

Scientific production and dissemination

13 October 2023, Bolzano, POLITO researcher from the AGRITECH national center at the Rai Radio 3 science Festival "Futuradio".
13 September, Spoke 8 meeting, Milan, with the contribution "Multi-dimensional evaluation of circular innovation technologies in agriculture, Lombardi P (Politecnico di Torino), Bacenetti J, Barbero S, Belcore E, Boschin G, Casti P, Catellani E, Costa S, Duce P, Fiore S, Garrone P, Luciano A, Molino A, Orlandella I, Piras A, Piras M, Ragagliani G, Randellini N, Rovera F, Tebaldi L, Todella E, Tommasi T, Vagnoni E, Vignali G".
Torino, Notte di ricercatori 2023, Stand "Come sta la Terra?" col Poster "L'ingegneria chimica nella gestione del suolo: il ruolo degli ammendanti", con POLITO-DISAT.
25th, 26th and 27th September, IEEE Conference on AgriFood Electronics (CAFE) with the contribution "Popillia Japonica Newman Detection Through Remote Sensing and Ai Computer Vision, D.Brusco, E.Belcore, M.Piras".
15 December 2023, geoAI conference, Torino, with the contribution "Detection and localization of dead chestnut trees (Castanea sativa Mill.) using UAV imagery and YOLOv8 vision AI: preliminary results. K. Smith, E. Belcore, M. Piras, M. Balestra, A. Vitali, E. Tonelli".
16 January 2024, Geomatics Youth Meeting, Rome, "Proximity sensing and Geomatics for precision agriculture. E. Belcore".
6 March 2024, researcher from the AGRITECH national center at the round table of the "Use of drones for combating Popillia japonica in vineyard" event in Novara (Italy).
16 May 2024, researcher from the AGRITECH national center presented as panelist of the "San Rossese Climate School", about the interaction between new technologies, agriculture, and climate. Camporosso (Italy).
2 July 2024, conference paper presentation at the International Conference on Agricultural Engineering (AgEng2024), titled "Orchard digital twin: a prototype for smart agricultural monitoring", Athens (Greece).