

# Assessment of Organic Amendments on Vegetative and Reproductive Performance of Strawberry Plants Under Different Growing Conditions

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The Ph.D. project aims at investigating the role of natural amendments and biostimulants of different origins and at different concentrations, on the vegeto-productive response of strawberry plants, grown *in vivo* (in pots and in the field) and *in vitro*. Mainly, morphological, physiological, biochemical, and nutritional quality attributes of plants and fruits will be evaluated to individuate the best combination of strawberry genotype, substrate composition, and growing conditions.

## 1. State-of-the-Art

The growth of the global population and the improvement in living conditions have led to an increase in the demand for food supply, to fulfil which agriculture has impacted strongly on the environment, and, moreover, has represented a potential health hazard to people; in fact, there has been an increasing recourse to synthetic products, such fertilizers and pesticides, but, at same time, recent years have seen an increment of agri-food waste, with about 2 billion tons generated annually worldwide (Wu *et al.*, 2020; Khan, 2022; Chhandama, 2022). To increase the agricultural sustainability, a strategy could be the reutilization of agri-food waste in agriculture to increase soil fertility, to reduce the use of chemical fertilizers and to improve plant vegeto-productive performances (Akram *et al.*, 2023); recently, there has been a fruitful scientific production about the use of natural and eco-friendly organic amendments, like biochar, and biostimulants (Mousavi-Avval *et al.*, 2023). Biochar derives from the anaerobic pyrolysis of agricultural waste, and it is known to improve the overall soil quality, microbial and enzymatic activity, and soil organic carbon content with nutrient retention and water availability (Elkhlifi *et al.*, 2023). Biostimulants are substances or microorganisms that are used to improve the nutrient uptake, to promote plant growth (germination, flowering, pollination, fructification, maturity, and crop quality), and to protect plants from biotic and abiotic stresses (Hijri, 2023); they trigger plant growth by solubilizing minerals, nitrogen fixation, and introducing phytohormones, secondary metabolites, volatile organic compounds, and lipopolysaccharides (Caulier *et al.*, 2019). Strawberry (*Fragaria×ananassa* L.) is highly appreciated for its high organoleptic and nutraceutical qualities, since it is rich in phenolic compounds, vitamins, and minerals (Garza-Alonso *et al.*, 2022). Biochar, alone or in combination with biostimulants, has already been applied to strawberry cultivation, enhancing, in the fruits, the enzymatic activity, the total soluble solid and the phenolic compound content, the total flavonoids, the beta-glucosidase activity and the phosphatase activity also (Shang *et al.*, 2021; Chiomento *et al.*, 2022). Other than in traditional agricultural systems, the use of biochar and biostimulants could be of enormous impact in strawberry tissue culture; in fact, micropropagation is highly dependent upon the use of plant growth regulators which may often be expensive and may cause aberrant and undesirable physiological and epigenetic disorders; moreover, toxic chemicals could be produced. Adding biostimulants to culture medium would help in replacing, *in toto* or partially, phytohormones, given their hormone-like properties; moreover, biochar can be a valid substitute of activated charcoal, for toxic compound absorption (Masondo *et al.*, 2022).

## 2. PhD Thesis Objectives and Milestones

The objectives and the different activities of the study are the following:

- A1) **Evaluation of biochar and biostimulants in *in vitro* strawberry tissue culture** vegeto-productive and physio-chemical response of *in vitro* plants will be monitored.
- A2) **Evaluation of different types and concentrations of biochar and wood distillate in strawberry cultivation in pots** morpho-physiological, physico-chemical response of strawberry plants grown in pots with different types and concentrations of biochar and wood distillate will be evaluated.
- A3) **Evaluation of different types and concentrations of biochar and wood distillate of strawberry cultivation in field** morpho-physiological, physico-chemical response of strawberry plants grown in field with different types and concentrations of biochar and wood distillate will be evaluated.
- A4) **Writing and Editing** the PhD thesis, scientific paper and oral or poster communications.

Timetable of proposed activities are summarized in the Gantt charts in Table 1.

**Table 1.** Gantt diagram for this PhD thesis project.

Activity	Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1) <i>Evaluation of Biochar and Biostimulants in In Vitro Strawberry Tissue Culture</i>																									
A2) <i>Evaluation of Different Types and Concentrations of Biochar and Wood Distillate in Strawberry Cultivation in Pots</i>																									
A3) <i>Evaluation of Different Types and Concentrations of Biochar and Wood Distillate of Strawberry Cultivation in Field</i>																									
A4) <i>Writing and Editing of Ph.D. Scientific Paper and Oral or Poster Communication</i>																									

### 3. Selected References

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