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Domain: HORTICULTURE

DOCTORAL THESIS

RESEARCH ON NITROGEN ACCUMULATION IN SEEDLINGS AND EDIBLE PARTS OF VEGETABLE SPECIES GROWN IN UNCONVENTIONAL SYSTEMS

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SUMMARY

of the doctoral thesis entitled:

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Doctoral Thesis: "*Research on nitrogen accumulation in seedlings and edible parts of vegetable species grown in unconventional systems*" presents the research conducted under greenhouse conditions on the species *Lactuca sativa* L., to observe how EC and pH levels influenced growth and nitrate accumulation in the analyzed lettuce varieties.

The thesis is written on a total of 160 pages and is divided into two parts: Part I, which consists of a single chapter, and Part II structured into 3 chapters. It also includes a Bibliography of 121 consulted references, 4 Annexes, and the author's List of publications.

PART I of the doctoral thesis presents a bibliographic study of research conducted on the use of structured water, as well as the need to understand the species under study.

In **CHAPTER I,** "*The current state of research on the importance of lettuce cultivation (Lactuca sativa L.)*", relevant and recent previous studies on the plant's characteristics and the influence of fertilization on nitrate accumulation in plants are presented, supported by specialized literature and data, to provide a complete and well-argued overview of your research.

PART II presents the original research, structured into 3 chapters, the Bibliography, the author's, 4 Annexes and List of publications.

This section presents the research objectives and goals, the context, and the relevance of the study.

The Aim of the Study. The aim of the study was to identify the best fertilization option for lettuce cultivation on a perlite substrate, as well as the potential to reduce nitrogen inputs and environmental impact.

To achieve the goal of this thesis, the following objectives were pursued:

Objective 1.

➤ Identifying growth differences by applying different EC and pH variants in cultivation

Objective 2.

➤ Identifying and quantifying the level of nitrogen accumulation in different edible parts of lettuce plants

➤ Comparing the efficiency of nitrogen absorption in unconventional vs. conventional systems

CHAPTER II, "*Study on the influence of pH and EC on the growth of lettuce plants cultivated on perlite substrate*," presents the data on the results obtained from cultivation during the period 2021-2023, including plant height growth, leaf number formation, plant diameter, plant mass, as well as the development of the root system, root length, and root mass. Correlations were made between the analyzed parameters and the EC and pH values used in the experiment. The varieties Kineta and Lugano, which are frequently cultivated, were used in the study.

It was found that there were differences in height, diameter, and mass growth depending on the experimental variants used and the year of cultivation. By conducting a comparative analysis between the years 2021, 2022, and 2023 for the Kineta and Lugano varieties, and varying the EC and pH parameters, some differences in height, diameter, and mass of the plants were observed. The results regarding plant height and diameter showed that the Kineta variety exhibited stable height growth from 15.13 cm in 2022 to 16.03 cm in 2023, with a relatively constant diameter, while the Lugano variety showed significant height growth from 11.33 cm in 2022 to 12.91 cm in 2023 and moderate diameter growth from 20.30 cm to 21.06 cm. The number of leaves for both varieties showed minor variations over the three years, with significant differences depending on the EC and pH levels. The root mass of the Kineta variety showed a slight increase from 5.81 g in 2022 to 6.11 g in 2023, while the Lugano variety showed larger variations in root mass from 3.67 g in 2022 to 4.72 g in 2023. EC and pH parameters indicated that an EC of 2.5 µS/cm was most favorable for both varieties in terms of plant mass, while a pH of 6 was optimal for plant growth over the three years. The performance of the varieties shows that the Kineta variety demonstrated stable growth and consistent performance, indicating adaptability and resilience in varied environmental conditions, while the Lugano variety showed significant growth in 2023, suggesting an optimization of growth conditions or better adaptation. The comparative analysis indicates that both varieties react differently to EC and pH variations, with the Kineta variety showing stability and the Lugano variety showing increased adaptability in 2023. Adjusting these parameters according to the specific characteristics of each variety can maximize the performance of lettuce plants.

In **CHAPTER III**, "*Chemical determinations performed on lettuce plants grown on perlite substrate*", its analyzed how variations in electrical conductivity (EC) and pH of the nutrient solution influenced the content of nitrates, sugars, dry matter, and chlorophyll in the two analyzed lettuce varieties, Lugano and Kineta, during the 2021-2023 research period.

The results provided a detailed picture of the interactions between these parameters and nitrate accumulation. At an EC of 1.5 µS/cm, the average nitrate content in the Lugano variety was 1454 mg/kg, while in the Kineta variety it was 1176 mg/kg. This indicated a higher accumulation of nitrates in Lugano compared to Kineta, even under low EC conditions. Increasing the EC to 2.5 µS/cm led to higher nitrate accumulation, with values of 1469 mg/kg for Lugano and 1151 mg/kg for Kineta. At an EC of 3.5 µS/cm, nitrate accumulation reached maximum values of 2294 mg/kg in Lugano and 1567 mg/kg in Kineta. These data indicated a positive correlation between EC and nitrate content, with a clear trend of increasing nitrate accumulation as the EC of the nutrient solution increases.

Regarding the pH of the nutrient solution, at pH 5, nitrate content was highest, 1386 mg/kg in Lugano and 588 mg/kg in Kineta at an EC of 1.5 µS/cm. Increasing the pH to 6 led to values of 1020 mg/kg for Lugano and 453 mg/kg for Kineta, while at pH 7, values significantly decreased, reaching 1020 mg/kg in Lugano and 453 mg/kg in Kineta. Similarly, at an EC of 2.5 µS/cm, nitrate content at pH 6 was 1627 mg/kg for Lugano and 1351 mg/kg for Kineta, while at pH 7, it was 1000 mg/kg for Lugano and 396 mg/kg for Kineta. At an EC of 3.5 µS/cm, values were 1806 mg/kg for Lugano and 1489 mg/kg for Kineta at pH 6, and at pH 7, nitrate content was 508 mg/kg for Lugano and 1512 mg/kg for Kineta.

These results indicate a decrease in nitrate content with increasing pH, especially at higher pH levels. The varieties showed significant differences in nitrate accumulation depending on environmental conditions. Lugano consistently accumulated a higher amount of nitrates than Kineta under all tested conditions, indicating a genetic difference in nitrate accumulation capacity or response to available nitrogen. This suggests that the Lugano variety has a greater tendency to accumulate nitrates under variable fertilization conditions compared to Kineta. The significant correlations observed between varieties, EC, and pH highlight the influence of these parameters on nitrate accumulation. Increasing EC is associated with higher nitrate content, indicating a direct influence of fertilization level on nitrate absorption and accumulation in plants. On the other hand, the pH of the nutrient solution influences the availability of nitrogen ions, with higher nitrate values at lower pH and a significant decrease at higher pH. In conclusion, the importance of both EC and pH in determining nitrate content in lettuce is highlighted, with variable effects between varieties. These observations are essential for

optimizing cultivation conditions and selecting appropriate varieties according to the specific requirements of the fertilization system.

The **bibliography** includes 121 references.