ABSTRACT

of the doctoral thesis entitled:

THE POSSIBILITIES OF PLANTING TIME ESTABLISHMENT FOR PERENNIAL WALL-ROCKET (*Diplotaxis tenuifolia* L.) UNDER GREENHOUSE

Ph.D-student: eng. Cristina PRECUPEANU
PhD Coordinator: Prof. habil. Vasile STOLERU, PhD
Co-supervisor: Assoc. Prof. Gianluca CARUSO, PhD

Keywords: diversity cultivation, planting time, mulching, fertilization, production.

The PhD thesis presents the results of a research on three perennial wall-rocket cultivars under three different planting time of crop establishment (sown and planted 10 days apart E1, E2, E3). The crop establishment was also studied under the influence of two different mulches (white and black) compared to the unmulched control and two fertilization regimes (organic and chemical) compared to the unfertilized.

Perennial wall-rocket is a leafy vegetable species belonging to the *Brasicaceae* family also known as wild arugula because it is recently cultivated from wild flora. It has numerous benefits when eaten, including: rich in antioxidants (vitamin C, polyphenols and flavonoids); supports digestion (stimulates gastric juices); natural detoxifier (helps liver and kidneys); source of vitamin K (important for bones and blood clotting); anti-inflammatory properties (due to sulphur compounds (glucosinolates); low calorie (~25 kcal/100 g); boosts immunity (high vitamin A and C content).

In Romania, this species has a very restricted history, being cultivated and studied very little. Due to its very high adaptability, this species has very high potential, especially at lower temperatures.

This doctoral thesis is structured in 178 pages comprising two parts, totaling seven chapters. The thesis also includes the bibliography, consisting of 145 references, 39 tables and 66 figures.

The 1-st part presents the current state of national and international knowledge on perennial wall-rocket and is composed of three chapters.

Chapter I deals with general considerations on perennial wall-rocket cultivation at national and international level. The benefits of perennial wall-rocket, its origin and taxonomy, the status of its worldwide distribution, the differences and similarities between perennial and annual arugula are presented.

Chapter II presents in detail the morphological particularities, ecological requirements and technological particularities of perennial wall-rocket.

During the chapter III are present studies on the practice of planting time, mulching and fertilization in horticulture with a focus on vegetable crops. The topic of practicing vegetable growing in greenhouse is also briefly discussed.

Part II consists of four chapters based on our own research.

Chapter IV presents data on the natural setting, "V. Adamachi" Iași Station of Research and Training for Students, where the experiment was carried out during the two years of study 2022-2023.

The chapter V, deals with the motivation for the research, the aims and objectives of the research and the materials and methodology for perennial wall-rocket.

Perennial wall-rocket (*Diplotaxis tenuifolia*) is a fourth-generation leafy vegetable species with high agronomic potential due to its ecological plasticity, nutritional value and increasing consumer demand. In Romania, this species is cultivated on very small areas and studies on its behavior under local agro-ecological conditions are few. Due to the interest in crop diversification and the use of sustainable technologies, this study aims to analyze the influence of crop establishment planting time, different mulching types and different fertilization regimes on the development of perennial wall-rocket, with a view to expanding this crop in Romania.

The aim of the PhD thesis was to evaluate the planting time under the influence of mulching and fertilization in three perennial wall-rocket cultivars.

By examining the interaction between these agricultural practices, the study focussed on identifying the most efficient methods for growing perennial wall-rocket under optimal conditions. In this study, we evaluated the behavior of three perennial wall-rocket cultivars, Le bon grain (Lbg), Seledor and Bologna, under the influence of three technological factors: planting time (with three gradations: 28.03 = Epoch 1, 7.04 = Epoch 2 and 17. 04 = Epoch 3), mulching (with three gradations: unmulched - Nem, mulching with white polyethylene film – WLDPE, and mulching with black polyethylene film – BLDPE.) and fertilization (with three gradations: unfertilized - Nef, organic fertilized with Italpollina - O, and chemical fertilization with KSC - Ch). The experiment was conducted in unheated tunnel, during the spring-summer cropping cycle, using a split-plot design with three replications.

In order to achieve this we have set the following objectives:

Objective 1: the individual and combined influence of the three factors considered in the study on yield, over the four harvests, for the Le bon grain cultivar under conditions specific to the period 2022-2023;

Objective 2: the individual and combined influence of the three factors considered in the study on yield, over the four harvests, for the Seledor cultivar under conditions specific to the period 2022-2023;

Objective 3: the individual and combined influence of the three factors considered in the study on yield, over the four harvests, for the Bologna cultivar under conditions specific to the period 2022-2023;

Objective 4: qualitative assessment of antioxidant activity (DPPH and ABTS), total phenolic content (TPC), tannins, chlorophyll a, chlorophyll b, lycopene, β-carotene and sugar content (fructose, glucose, sucrose) for the three cultivars studied.

Chapter five also presents the study material consisting of three perennial wall-rocket cultivars (Le bon grain, Seledor and Bologna), the experimental protocol and the methods for analyzing quantitative and qualitative parameters.

The results of the quantitative analyses were summarized by elements such as: mass of leaves, number of leaves, leaf area per nest and yield per hectare. The qualitative analyses refer to the percentage of dry matter, chlorophyll content index (CCI), CO_2 assimilation rate (μmol $CO_2/m^2/s$), antioxidant activity (DPPH and ABTS), total polyphenol content (TPC), tannins, chlorophyll A, chlorophyll B, lycopene and β-carotene. Leaf gas exchange parameters were analyzed using a portable LCpro T® intelligent photosynthesis system (ADC BioScientific Ltd., Hoddesdon, Hertfordshire, UK). Leaf area index (LAI) was analyzed using a Li-3100® area meter manufactured by LICOR, Inc., Lincoln, NE, USA. The dry mass of each sample was determined by drying in a MOV-112 F oven (SANYO Electric Co., Ltd., Osaka, Japan) at 70 °C to constant weight. The dried samples were subsequently used to determine the content of functional compounds and lipophilic pigments.

Chapter VI is structured in three parts that focus on presenting the quantitative results for each cultivar. Thus, for each cultivar, first the individual influence of the individual influence of the planting time, mulching and fertilization is presented and then the influence of the interaction of the three factors is presented. The following items are discussed in this chapter: mass per nest (g), number of leaves per nest, leaf area per nest (cm^2), yield per cultivar as a function of the factors considered (sampling, mulching, fertilization), dry matter (%), moisture (%), pigments (CCI), CO_2 assimilation rate (μmol $CO_2/m^2/s$), yield resulting from the interaction of the factors analyzed and yield per four harvests for each planting time.

Also in this chapter, principal component analysis (PCA) was performed for the cultivar Bologna to reduce the dimensionality of the data while preserving

important variability, effectively summarizing the dominant patterns and relationships, and Pearson correlation coefficients were analyzed and calculated to assess the linear relationships between the traits analyzed.

It can be seen that in the first epoch the highest production values were obtained for all three cultivars, thus for Le bon grain a quantity of 55.7 t/ha was obtained, for Seledor 51.68 t/ha, for Bologna 53.90 t/ha.

In the case of mulching, white mulch positively influenced the final yield of all three cultivars analyzed, with the highest values for Le bon grain (54.97 t/ha), Seledor (53.09 t/ha) and Bologna (55.91 t/ha).

For the fertilisation factor, the highest yield was given by chemical fertilisation for Le bon grain (56.07 t/ha) and for Seledor (53.06 t/ha), while the highest yield for Bologna was obtained by organic fertilisation (55.67 t/ha).

The interaction of the analysed factors for the cultivar Lbg resulted in the highest yield for the first epoch x white film mulching x chemical fertilization with a yield of 66.52 t/ha, for Seledor epoch 1, unmulched and chemically fertilized with a value of 57.57 t/ha and for Bologna x epoch 1 x white film and organic fertilized with a value of 63.96 t/ha.

Chapter VII focuses on the quality results of perennial wall-rocket as a function of the three cultivars, mulching and fertilization. The quality results presented in this chapter concern: TPC, tannins, DPPH, ABTS, chlorophyll A, chlorophyll B, lycopene, β-carotene and sugar content (fructose, glucose and sucrose).

Antioxidant activity (DPPH, ABTS) obtained the highest values for Lbg and Seledor cultivars. The interaction of the analyzed factors that most influenced the antioxidant activity is Seledor x Nem x Ch with a value of 0.71 mmol TE/100 g s.u.

The total polyphenol content obtained the highest value for the cultivar Seledor 2,03 mg GAE/100 g s.u. This cultivar, Seledor, had the lowest value for tannins 0.05 mmol/100 g s.u. The highest value for TPC, in terms of the interaction of the factors analyzed, was obtained in Bologna x WLDPE x Nef with a value of 2.17 mg GAE/100 g s.u. In the case of tannins, for the combined influence of the analyzed factors, the highest amount was obtained for the combination of Lbg x BLDPE. x O with a value of 0.07 mmol/100 g s.u. and the lowest amount of 0.05 mmol/100 g s.u. was obtained for the following variants: Seledor x Nem x O, Seledor x WLDPE x O, Bologna x Nem x O.

The content of chlorophyll pigments was found in the highest amounts for the cultivar Lbg, (Cl-a = 95.40; Cl-b = 42.70 mg/100 g s.u.). Lycopene in the highest amount was found in the cultivar Bologna with a value of 9.44 mg/100 g s.u. and β-carotene in the highest amount was found in the cultivar Lbg with a value of 5.74 mg/100 g s.u.

The interaction of cultivar Lbg x Nem x O resulted in the highest values for Cl-a (119.63 mg/100 g s.u.) and Cl-b (52.38 mg/100 g s.u.). The highest amount of lycopene was found of the Lbg x BLDPE. x Ch combination 10.63 mg/100 g s.u. and for β-carotene of the Lbg x Nem x O variety 8.85 mg/100 g s.u.

The amount of sugar, a very important item in the composition of perennial wall-rocket due to its influence on its taste, shows that among the cultivars analyzed, Lbg could be the most accepted by consumers who do not like arugula very well. Mulching recorded the highest amount of sucrose and fructose for the BLDPE (1.14 g/100 g s.u. respectively 0.98 g/100 g s.u.) and for glucose the highest amount was identified for the unmulched variety (7.73 g/100 g s.u.). In the case of fertilization, the highest amount was found in the chemically fertilized variants for fructose (1.14 g/100 g s.u.) and sucrose (0.91 g/100 g s.u.), the differences being quite small compared to the organic fertilized variants which recorded the highest amount of glucose 7.57 g/100 g s.u. The interaction of the analyzed factors influenced the sugar content in perennial wall-rocket leaves as follows: fructose was the highest for the Lbg x BLDPE x Nef variety with a value of 1.31 g/100 g s.u., glucose was the highest for the Bologna x Nem x Ch variety with a value of 8.44 g/100 g s.u., and sucrose was the highest for the Lbg x BLDPE x Ch variety with a value of 1.35 g/100 g s.u.

Among the cultivars analyzed, the Le bon grain cultivar stands out in terms of yield per hectare and and biomass quality. Considering all the factors analyzed according to the destination of the crop, the cultivation technology that positively influences the item under study is applied, as well as the cultivar that largely meets the preferences of the targeted consumer group.