IMPACT OF DIFFERENT CULTIVATION PRACTICES ON THE PERENNIAL WALL-ROCKET IN GREENHOUSES

IMPACTUL DIFERITELOR PRACTICI DE CULTIVARE ASUPRA RUCOLEI PERENE ÎN SOLAR

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Abstract.
Evaluation of best practices for planting time, mulching and fertilization of perennial wall-rocket (Diplotaxis tenuifolia) in Romania is an important step in development of sustainable and efficient agriculture. In the context of the diversity of climatic and soil conditions in Romania, identifying the most appropriate agricultural techniques for this crop becomes essential to ensure both crop productivity and quality. By analysing the interaction between these agricultural practices, the study aimed to identify the most efficient methods for growing perennial wall-rocket under optimal conditions. Within it, we evaluated the behaviour of the variety, Bologna, under influence of three technological factors, in two experimental years (2022-2023): planting time (with three gradations: 28.03 = Epoch 1, 7.04 = Epoch 2 and 17.04 = Epoch 3), mulching (with three gradations: non mulching - NM, mulching with white polyethylene film - WLDPE, and mulching with black polyethylene film - BLDPE) and fertilization (with three gradations: unfertilized - NF, organic fertilized - O, and chemical fertilization - Ch). The experiment was conducted in an unheated plot, during the winter-summer cropping cycle, using a split-plot design with three replications. For the Epoch factor, the highest yield resulted from the first Epoch, 53.90 t ha^{-1}. For the mulching factor the highest yield resulted from WLDPE 55.91 t ha^{-1}. For the fertilization factor the highest yield was obtained from the organic fertilized, 55.67 t ha^{-1}.
Key words: Planting time, Mulching, Fertilization, Bologna.

Rezumat.
Evaluarea celor mai bune practici privind epoca de plantare, mulcirea și fertilizarea culturilor de rucola perenă (Diplotaxis tenuifolia) în România reprezintă un pas important în dezvoltarea unei agriculturi durabile și eficiente. În contextul diversității condițiilor climatice și pedologice din România, identificarea celor mai adecvate tehnici agricole pentru această cultură devine esențială pentru a asigura atât productivitatea, cât și calitatea culturii. Analizând interacțiunea dintre aceste practici

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agricole, studiul a urmărit să identifice cele mai eficiente metode de cultivare a rucolei perene în condiții optime. În cadrul acestuia, am evaluat comportamentul soiului Bologna sub influența a trei factori tehnologici, în doi ani experimentali (2022-2023): epoca de plantare (cu trei graduații: 28.03 = Epoca 1, 7.04 = Epoca 2 și 17. 04 = Epoca 3), mulcirea (cu trei graduații: nemulcit - NM, mulcirea cu folie de polietilenă albă - WLDPE și mulcirea cu folie de polietilenă neagră - BLDPE) și fertilizarea (cu trei graduații: nefertilizat - NF, fertilizat organic - O și fertilizat chimic - Ch). Experimentul a fost realizat într-o parcelă neîncălzită, în timpul ciclului de cultură iarnă-vară, folosind un plan de tip split-plot cu trei repetiții. Pentru factorul epocă, cea mai mare producție a fost obținută de prima epocă, 53,90 t/ha. Pentru factorul mulcire, cea mai mare producție a fost obținută de mulcirea cu folie albă, 55,91 t/ha. În ceea ce privește factorul fertilizare, cea mai mare producție a fost obținută de fertilizarea organică, 55,67 t/ha.

Cuvinte cheie: epoca de plantare, mulcire, fertilizare, bologna.

INTRODUCTION

In the last twenty years, as a result of the continuous growth of the global population, technological advances in horticultural systems for greenhouse vegetable production have been aimed at increasing production. These improvements focus on optimizing planting timing, climate control, irrigation and nutrient supply to increase productivity and ensure sustainability of food resources [Stoleru *et al.*, 2020].

Diplotaxis tenuifolia, commonly known as perennial wall-rocket, is a leafy vegetable belonging to the *Brassicaceae* family and is specific to the Mediterranean region. Recently, it has been cultivated from wild flora [Bonasia *et al.*, 2019]. Its popularity is increasing due to its unique flavour, attributed to isothiocyanates, and its wide range of beneficial compounds [Signore *et al.*, 2023]. In Romania, the study of perennial wall-rocket has only recently begun. Cultivating perennial wall-rocket contributes to more sustainable agriculture, as it requires less soil preparation and enhances soil structure over time, reducing soil erosion and the need for fertilizers. Additionally, consumption of perennial wall-rocket has risen due to its recognized nutritional benefits. The staggered crop production ensures a steady supply of fresh produce to the market, meeting consumer demand and providing farmers with a reliable income [Precupeanu *et al.*, 2024].

The planting time (Epoch) is a critical factor influencing the growth and development of perennial wall-rocket. In Romania, where the climate varies significantly from region to region, determining the optimal planting time is essential for adapting the crop to local conditions. By evaluating different planting periods, valuable information can be gathered to maximize yield, ensuring that plants benefit from the best conditions for germination and development in accordance with the climatic characteristics of the region.

Mulching is an essential agricultural practice for water management and weed control, especially given the specific soil conditions in Romania. Applying a

mulch layer helps conserve soil moisture, maintain optimal soil temperature, and prevent soil erosion. Additionally, mulching can improve soil structure, making it more conducive to the growth of perennial wall-rocket. Evaluating various mulch materials and application methodologies is necessary to determine the most effective techniques to meet the crop's specific needs in different parts of the country [Teliban *et al.*, 2020].

Fertilization plays an important role in maximizing the yield potential of perennial wall-rocket. In the context of Romanian agriculture, where soils can vary significantly across regions, it is crucial to establish fertilization regimes tailored to local specificities. In conclusion, evaluating best practices regarding planting time, mulching, and fertilization of perennial wall-rocket in Romania is vital for developing sustainable and efficient agriculture. This approach will not only help optimize production and crop quality but also contribute to the protection of natural resources and the adaptation of agricultural techniques to the diverse soil and climatic conditions in Romania.

MATERIAL AND METHOD

The Bologna cultivar, known for its excellent productivity and flavour, was sourced from Italy for study. The seedlings were produced at the Research Institute for Agriculture and Environment (ICAM) of the Agronomic University of Iași in a greenhouse equipped with advanced technology for climate, irrigation, and light control. Sowing was conducted in cellular pallets at a temperature of 18-20°C, with seedlings planted 10 days apart to adhere to the planting schedule. After 30 days, the seedlings were transplanted into a polytunnel [Hall *et al.*, 2012] located at the Horticultural Farm V. Adamachi, covering an area 5.6 meters wide and 22 meters long. The planting scheme consisted of three raised beds, each containing four rows of plants, with a spacing of 25 cm between plants per row, 20 cm between rows, and 15 cm from the edge of the bed, resulting in a density of 89,000 plants per hectare. At the time of planting, basal fertilization was performed using Italpollina and KSC, which were dissolved in water for uniform application. Black and white polyethylene mulch sheets were applied to the soil to protect the plants and create a microclimate conducive to growth. These mulch films significantly impacted light, which is essential for warming and promoting plant growth [Caruso *et al.*, 2018].

After planting, maintenance activities such as weed control, disease and pest treatments, and drip irrigation were implemented. Harvesting occurred four times during each growing season, with the first harvest taking place 30 days after planting, followed by three additional harvests at 30-day intervals. The leaves of perennial wall-rocket (*Diplotaxis tenuifolia*) were harvested by cutting them at a height of 3-5 cm above the cotyledons to protect the regenerating shoots [Schiattone *et al.*, 2018]. The leaves were harvested when they reached a size of 10-15 cm, as the smaller leaves had a more delicate flavour, while the larger ones became more pungent and bitter. After harvesting, the leaves were transported to the laboratory and stored in cold conditions to preserve their freshness for analysis. Nest mass, leaf number, leaf area, percent dry matter, water content, chlorophyll pigments and photosynthetic assimilation rate (A) were analysed at each harvest. Gas exchange parameters were measured with a portable photosynthesis system and chlorophyll content with a portable meter, CCM-200 plus. Leaf area index (LAI) was determined with a Li-3100 leaf area meter. Dry

matter was measured by dehydrating leaves at 70°C. Data were processed in Excel and compared by Duncan test (P = 0.05) using SPSS 26 software.

RESULTS

The results of the influence of grading on the productivity of the Bologna cultivar over the two years of the experiment indicate that the highest production was achieved in the first grading, with a clutch mass of 605.57 g, 651 leaves, and a leaf area of 10,515.44 cm². In contrast, the lowest production was recorded in the last sampling, with a mass of 561.32 g, 539 leaves, and a leaf area of 9,386.82 cm².

Mulching with white film yielded the best results, with a clutch mass of 628.14 g, 615 leaves, and a leaf area of 10,583.37 cm². Conversely, mulching with black film produced the lowest values, with a mass of 536.84 g and a leaf area of 9,372.37 cm². Organic fertilization had a positive impact, resulting in a crop mass of 625.48 g, 612 leaves, and a leaf area of 10,592.57 cm². The chemically fertilized variety had the highest number of leaves (613), while the non-fertilized variety exhibited the lowest values, with a mass of 528.08 g and a leaf area of 9,174.12 cm² (Table 1).

Table 1

Influence of staggering on yield parameters in the cultivar Bologna

Experimental version	Weight/nest (g)	No. of leaves/nest	LAI ($cm^2 \cdot cm^{-2}$)
PLANTING TIME			
Epoch I	605.57 ± 14.09 a	650.91 ± 14.55 a	10515.44 ± 208.92 a
Epoch II	595.18 ± 13.57 ab	604.18 ± 10.13 b	10318.74 ± 220.59 a
Epoch III	561.32 ± 4.44 b	538.59 ± 3.29 c	9386.82 ± 112.41 b
Signification	*	*	*
MULCH TYPE			
NM	597.09 ± 12.23 a	599.95 ± 4.97 ab	10265.25 ± 203.86 a
WLDPE	628.14 ± 14.36 a	614.07 ± 10.27 a	10583.37 ± 196.63 a
BLDPE	536.84 ± 2.56 b	579.65 ± 11.98 b	9372.37 ± 41.89 b
Signification	*	*	*
FERTILIZATION TYPE			
NF	528.08 ± 9.64 b	568.71 ± 15.02 b	9174.12 ± 144.23 b
O.	625.48 ± 7.23 a	611.98 ± 6.14 a	10592.57 ± 57.46 a
Ch.	608.51 ± 15.49 a	612.98 ± 8.63 a	10454.30 ± 188.72 a
Signification	*	*	*

NM=non-mulched, WLDPE=mulched with white polyethylene film, BLDPE=mulched with black polyethylene film, NF=non-fertilized, O=organically fertilized, Ch.=chemical fertilization. Values are means ± standard error from three independent replicates. One-way ANOVA procedure followed by Duncan test was used to assess statistical significance. Different lowercase letters (a-d) in the same line indicate statistically significant differences between perennial arugula groups at p≤ 0.05. a is the highest value among all values analysed.

During the two years of the experiment (2022-2023), the influence of staggering, mulching, and fertilization on the yield of the Bologna cultivar

demonstrated that the first staggering achieved the highest yield of 53.90 t/ha, while the last staggering resulted in the lowest yield of 49.96 t/ha (Figure 1). Mulching with white film produced the highest yield at 55.91 t/ha, whereas black mulch yielded only 47.78 t/ha. Organic fertilization resulted in the best yield of 55.67 t/ha, followed by chemical fertilization at 54.16 t/ha, while the unfertilized variant recorded the lowest yield of 47 t/ha.

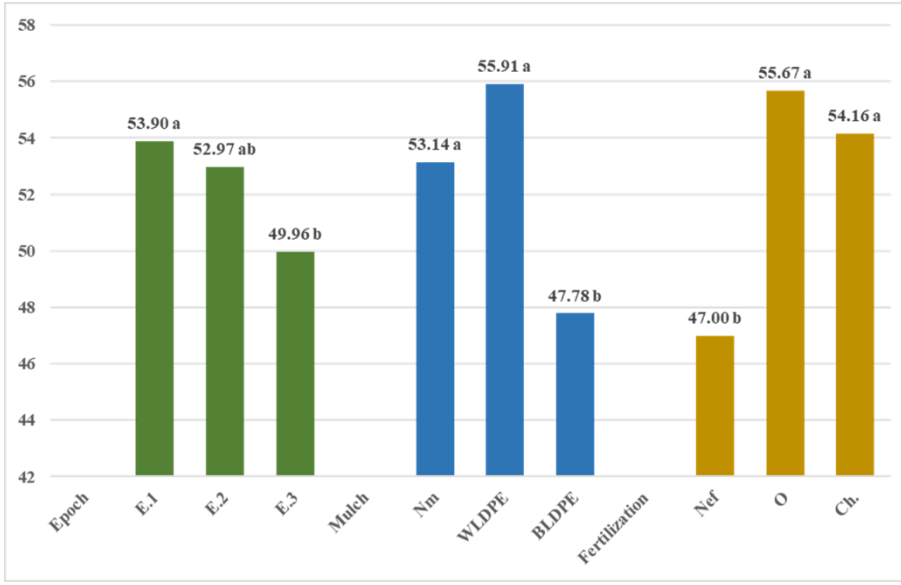

Fig. 1. Average yield over the two years for Bologna (t/ha)
(NM=non-mulched, WLDPE=mulched with white polyethylene film, BLDPE=mulched with black polyethylene film, NF=non-fertilized, O=organically fertilized, Ch.=chemical fertilization)

The results regarding the influence of sampling on the quality indices for the Bologna cultivar (2022-2023) indicate that the highest dry matter content (8.90%) and the lowest moisture content (91.11%) were recorded at the third sampling, while the first sampling exhibited the highest moisture content (91.86%) and the lowest dry matter content (8.14%). In terms of chlorophyll pigments, the first sampling had the highest content (18.32 CCI), while the last sampling recorded the lowest (16.67 CCI).

Mulching with black film resulted in the highest dry matter content (8.59%) and the lowest moisture content (91.41%), whereas mulching with white film yielded the highest chlorophyll pigment content (17.50 CCI) and the highest assimilation rate (13.52). Chemical fertilization produced the highest dry matter content (8.69%) and the lowest moisture content (91.31%), while organic fertilization resulted in the highest assimilation rate (13.06). The non-fertilized variant had the highest chlorophyll pigment content (17.66 CCI) but the lowest assimilation rate (11.86) (Table 2)

Table 2

Influence of mulching on quality parameters in Bologna cultivar

Experimental version	Dry matter (%)	Humidity (%)	Chlorophyll pigments (CCI)	A (μmol m^{-2} s^{-1})
PLANTING TIME				
Epoch I	8.14 ± 0.14 b	91.86 ± 0.14 a	18.32 ± 0.25 a	10.60 ± 0.10 b
Epoch II	8.19 ± 0.12 b	91.81 ± 0.12 a	17.00 ± 0.23 b	12.93 ± 0.19 a
Epoch III	8.90 ± 0.11 a	91.11 ± 0.11 b	16.67 ± 0.12 b	13.36 ± 0.07 a
Signification	*	*	ns	ns
MULCH TYPE				
NM	8.37 ± 0.10 a	91.63 ± 0.10 a	17.37 ± 0.25 a	12.14 ± 0.06 b
WLDPE	8.27 ± 0.16 a	91.73 ± 0.16 a	17.50 ± 0.08 a	13.52 ± 0.18 a
BLDPE	8.59 ± 0.11 a	91.41 ± 0.11 a	17.13 ± 0.18 a	11.22 ± 0.12 c
Signification	*	*	ns	*
FERTILIZATION TYPE				
NF	8.21 ± 0.12 b	91.79 ± 0.12 a	17.66 ± 0.14 a	11.86 ± 0.08 b
O.	8.33 ± 0.11 ab	91.67 ± 0.11 ab	17.36 ± 0.21 ab	13.06 ± 0.20 a
Ch.	8.69 ± 0.14 a	91.31 ± 0.14 b	16.98 ± 0.18 b	11.97 ± 0.07 b
Signification	*	*	*	*

NM=non-mulched, WLDPE=mulched with white polyethylene film, BLDPE=mulched with black polyethylene film, NF=non-fertilized, O=organically fertilized, Ch.=chemical fertilization. Values are means ± standard error from three independent replicates. One-way ANOVA procedure followed by Duncan test was used to assess statistical significance. Different lowercase letters (a-d) in the same line indicate statistically significant differences between perennial arugula groups at $p \leq 0.05$. a is the highest value among all values analysed.

CONCLUSIONS

Following the analysis of the results, it was found that the highest yields were recorded for the variety planted in the first epoch, with a yield of 53.90 t/ha, for the variety covered with white film at 55.90 t/ha, and for the organically fertilized variety at 55.67 t/ha. The results indicate that the cultivation practices applied significantly influence the perennial arugula crop. Therefore, depending on the crop's intended use, it is recommended to implement cultivation practices that positively impact the desired outcomes.

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