

RESEARCH ON THE INFLUENCE OF CULTIVAR AND MICROPOROUS FILM ON THE EARLY PRODUCTION OF ORGANIC LETTUCE GROWN IN GREENHOUSES

Mihai CARBUNAR^{1#}, Iuliana Teodora VIDICAN¹, Andrada Iulia IENCIU¹, Mihaela Lavinia CĂRBUNAR², Adrian FELEA¹

¹ University of Oradea, Faculty of Environmental Protection, Oradea City, Magheru 26, 410087, Romania Institution

² University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Mănăstur Street 3-5, 400372 Cluj-Napoca, Romania

RESEARCH ARTICLE

Abstract

Lettuce is the most consumed vegetable during the colder period of the year, and in some countries, it is consumed throughout the year. Early lettuce production cultivated in greenhouses can be enhanced through various methods, using different materials that provide better insulation than polyethylene films. Microporous film with different densities is one of the factors tested, and the second factor is the cultivar, with five grades. The purpose of the research is to determine how these two factors influence early lettuce production. The experimental results highlighted the positive influence of microporous film on early production in the cultivars studied. The denser film had a varied effect depending on the variety.

Keywords: Lettuce, microporous foil, cultivar, density;
#Corresponding author: carbunar@yahoo.com

INTRODUCTION

As a science, organic agriculture deals with the systematic study of the material structures (living organisms and their environment) and functional structures (intra and inter-relationships of material structures) of agricultural systems in order to establish principles, norms (standards) and recommendations for the design and management of agroecosystems capable of ensuring, for a long time, human needs for food, clothing and housing, without diminishing their ecological, economic and social potential.

The main constraint in vegetable cultivation is seasonal weather conditions and climate change with a strong impact on agriculture and global food security, a phenomenon that is expected to increase the coming years.

Vegetables represent an important constant in daily human consumption and a continuously growing population seriously poses the problem of finding viable alternatives in order to maximize the yield of vegetable crops as a crucial need for adaptation. Lettuce has a large share in the total consumption of vegetables and this is due to several considerations. Thus, according to Voinea, Gherman, (1974), 100 g of lettuce leaves contains: 43 mg Ca, 32 mg P, 0.3 mg Fe, 350 mg K, as well as a series of vitamins such as:

vitamin C 15 mg, vitamin A 4.2 mg, vitamins from group B – B1 0.07 mg, B2 0.08 mg, PP (B3) 0.5 mg. The lettuce also contains: 1.25% total sugar, 0.1% titratable acidity, 0.017 polyphenols, 0.5% cellulose out of a total of 6.1% dry matter (Tudor, 1989). Based on a comparison of 93 countries in 2022, China ranked first in lettuce and chicory production, with 14,978 kt, followed by the USA and India. At the opposite end were Djibouti with < 0.001 kt, Brunei with 0.009 kt and Slovakia with 0.070 kt.

The total production of lettuce and chicory reached 27,149 kt in 2022 worldwide, according to Faostat. This is 0.32% less than the previous year and 5.20% more than 10 years ago.

Since low temperatures cause great damage to vegetable crops, various methods, equipment and technologies have been developed to protect them. Among the classic methods, we mention the cultivation of vegetables in greenhouses, which ensures a certain permanence of production during the winter period (Ummiyah et al, 2017) and allows for extra-early crops (Pachiyappan et al., 2022). The specialized literature mentions that in a cold greenhouse a temperature is maintained approximately 5°C higher than the outside one, also reducing the need for irrigation water by up to 35.6% (Shukla et al., 2024).

The use of thermal insulation films is another greenhouse effect method that leads to a temperature gain of 1 to 4°C, thus allowing the growth of vegetables in the off-season. Mulching with polyethylene sheets of different colors protects the plant from frost by acting as an insulator, in *Lactuca sativa* crops, it has a positive effect on increasing yield (Toic et al., 2014), also determined the increase in the number and width of leaves, plant height, biological yield, root volume and dry matter (Tiru et al, 2018). The use of organic mulch (cereal straw, leaves, pine needles, etc.) is found in organic crops and has an important role in improving soil properties (Muscalu et al., 2020).

Since the physiological, biochemical and metabolic activities of plants are temperature dependent, it has become urgent to develop appropriate strategies for the protection of vegetable crops that include a holistic approach that aims, in addition to improving existing production systems and better exploiting biodiversity, to apply biotechnology and studies on genetic modification of different stress tolerances and the development of appropriate vegetable species (Ibrahim, 2021). With the advent of new omics technologies for genomics-assisted breeding and new approaches, namely gene editing and rapid breeding, the process has shortened the time required to create and release new temperature-resistant vegetable varieties (Saeed et al., 2023).

New research on field crops of *Lactuca sativa* demonstrates that exogenous and separate application of salicylic acid, ascorbic acid or calcium chloride ameliorates abiotic

stress with the greatest efficiency against frost at -12°C (Perry, et al, 2024). According to Fodorpataki et al., priming can be an effective pretreatment of plants to enhance their ability to cope with adverse growing conditions and to improve their defensive metabolism. Priming with vitamin U prepared *Lactuca sativa* seedlings for cold stress and resulted in increased carotenoid pigments and vitamin C content in the leaves (Fodorpataki et al, 2019).

In 2021, by applying “natural plant antifreezes” to open field, mulched, low tunnel, low tunnel + mulch crops of *Lactuca sativa* L. established in the fall, the results suggested that the treatment led to improved yield and number of leaves per plant (Pirinç, Alas, 2021). Another study demonstrates that there is a collection of bacteria that colonize the roots of *Lactuca sativa* L. that play an important role in the growth and quality of lettuce plants in cold conditions (Persyn et al., 2024).

The future is of innovations, so the severe frost damage to vegetable crops has determined the development of new technologies, the process is based on air disturbance technology with a frost protection role, the structures and applicability have three types of working models: conventional wind turbines, turbines with inverted selective exhaust and portable vertical blowing (Hu, et al., 2018). According to Chenkov et al., (1974) the optimal temperature for growth and head formation can be 20-22°C in sunny weather, 15-16°C in cloudy weather, and during the winter months it is 12-13°C and even 7-8°C.

MATERIAL AND METHOD

Research on the influence of the cultivar and protection of lettuce on early production was carried out in 2024 in an organic vegetable microfarm in the locality of Husasău de Tinca, a locality located in NW Romania, in a transition area from the plains to the western piedmonts. The vegetable microfarm has as its main objective the cultivation of organic vegetables in solariums and only ¼ vegetables in the field. The total area is 0.4 ha, the research on lettuce was carried out in solariums. The experience had two factors, namely:

Factor A, protection with microporous foil, with three grades:

A1- unprotected Ct

A2- protected with microporous foil (Agril) with a density of 17g/m²

A3- protected with microporous foil (Agril) with a density of 30g/m²

Factor B, the cultivar, with five grades:

C1- Tuareg

C2- Dorée de prentemps

C3- Lollo rossa

C4- Flame

C5- Jester

By combining the two factors, 18 experimental variants resulted. Each variant had a number of 15 plants. The bifactorial experiment was arranged according to the method of subdivided blocks, with 18 variants in 3 repetitions. The statistical processing of the experimental data was done by analysis of variance.

RESULTS AND DISCUSSIONS

Lettuce cultivation has a large share, especially during the cold period of the year, solariums being the ideal space in this regard. The efficient use of solariums can be achieved by cultivating and succession of crops, so that through various technological methods the period from the establishment of the crop to the harvest is reduced.

The main goal of the present research is to obtain an early production of lettuce in solariums, using protection with microporous foil and how this influences several lettuce varieties cultivated in the microfarm chosen for research.

Table 1

Cr. no.	Variant	Absolute production of Lettuce (kg/m ²)	Relative production of Lettuce (%)	± d (kg/m ²)	Significance
1	C0 Ct	1,91	100,0	0,00	-
2	C1	1,69	88,3	-0,22	0
3	C2	2,24	117,2	0,33	xx
4	C3	0,93	48,6	-0,98	000
5	C4	1,93	101,0	0,02	-
6	C5	2,77	144,9	0,86	xxx

LSD_{5%}=0,16 LSD_{1%}=0,23 LSD_{0,1%}=0,35

The first element analyzed refers to the influence of factor C. The results regarding the influence of the cultivar on the early production of lettuce are presented in Table 1. In this case, the control was the average of the experiment. Compared to the control, the best results were recorded by the Jester variety, with an absolute production of 2.77 kg/m², 0.86 kg/m² more than the average of the experiment, the difference being statistically assured, very significant. The Dorée de

pretempis variety, with an early production increase of 17.2% compared to the control, the difference was statistically assured, distinctly significant. The varieties, Tuareg and Lollo rossa, had productions below the average of the experiment. Thus, the Lollo rossa variety recorded only 48.6% of the production of the control, the difference from it was statistically assured, negatively very significant.

Table 2

Cr. no.	Variant	Absolute production of Lettuce (kg/m ²)	Relative production of Lettuce (%)	± d (kg/m ²)	Significance
1	A1Ct	1,53	100,0	0,00	-
2	A2	1,90	123,9	0,37	xxx
3	A3	2,32	151,4	0,79	xxx

LSD_{5%}=0,12 LSD_{1%}=0,16 LSD_{0,1%}=0,22

The influence of factor A, respectively of the protective foil, is presented in table 2. Compared to the control (without foil), both variants covered with microporous foil considerably influenced the early production of lettuce. In the variant covered with

microporous foil with a density of 17g/m², the production increase was 23.9%, and in the one with a density of 30 g/m², the increase was 51.4%. In both, the difference from the control was statistically very significant.

Table 3

Interaction between A to C Husasău de Tinca, 2024					
Cr. no.	Variant	Absolute production of Lettuce (kg/m ²)	Relative production of Lettuce (%)	± d (kg/m ²)	Significance
1	A1C1 Ct	1,27	100	0,00	-
2	A2C1	1,72	1,35	0,45	xx
3	A3C1	2,08	163,8	0,81	xxx
4	A1C2 Ct	1,85	100,0	0,00	-
5	A2C2	2,12	114,6	0,27	x
6	A3C2	2,76	149,2	0,91	xxx
7	A1C3 Ct	0,68	100,0	0,00	-
8	A2C3	0,95	139,7	0,27	x
9	A3C3	1,16	170,6	0,48	xx
10	A1C4 Ct	1,67	100,0	0,00	-
11	A2C4	1,98	118,6	0,31	x
12	A3C4	2,15	128,7	0,48	xx
13	A1C5 Ct	2,18	100,0	0,00	-
14	A2C1	2,71	124,3	0,53	xxx
15	A3C5	3,43	157,3	1,25	xxx

LSD_{5%}=0,26 LSD_{1%}=0,35 LSD_{0,1%}=0,41

Regarding the interaction A to C, i.e. the interaction of the protective film with the cultivar, the results of the interaction are presented in Table 3. Analyzing Table 3 as a whole, it can be seen that the microporous protective films influenced to a lesser or greater extent the early lettuce production in all the cultivars studied. The Jester variety reacted best to both the film with a density of 17g/m² and the one with 30g/m². The variant with the less dense film recorded 0.53 kg/m² more, and the film with a density of 30 g/m² obtained 1.25 kg/m² more than the control. In

both variants, the differences compared to the uncovered variant were statistically ensured, very significant. A curious interaction was observed in the Dorée de prentemps variety. Thus, if with the 17g/m² film protection, the variety exceeded the control's production by 0.27 kg/m², in the case of the 30g/m² film density, the early production was 0.91 kg/m² higher than the control. In the first case, the difference was statistically significant, and with the denser film, very significant.

Table 4

Interaction between C to A Husasău de Tinca, 2024					
Cr. no.	Variant	Absolute production of Lettuce (kg/m ²)	Relative production of Lettuce (%)	± d (kg/m ²)	Significance
1	C0A1 Ct	1,53	100,0	0,00	-
2	C1A1	1,27	83,0	-0,26	-
3	C2A1	1,85	120,9	0,32	x
4	C3A1	0,68	44,4	-0,85	000
5	C4A1	1,67	109,2	0,14	-
6	C5A1	2,18	142,5	0,65	xxx
7	C0A2 Ct	1,90	100,0	0,00	-
8	C1A2	1,72	90,7	-0,18	-
9	C2A2	2,12	111,8	0,22	-
10	C3A2	0,95	50,1	-0,95	000
11	C4A2	1,98	104,4	0,08	-
12	C5A2	2,71	142,9	0,81	xxx
13	C0A3 Ct	2,32	100,0	0,00	-
14	C1A3	2,08	89,8	-0,24	-
15	C2A3	2,76	119,2	0,44	xx
16	C3A3	1,16	50,1	-1,16	000
17	C4A3	2,15	92,8	-0,17	-
18	C5A3	3,43	148,1	1,11	xxx

LSD_{5%}=0,27 LSD_{1%}=0,37 LSD_{0,1%}=0,52

The last element analyzed in the present experience was the interaction of the cultivar with the protective film. And in this case the

Jester variety stood out, even without protective film its production exceeded the average of the five varieties, so the difference

was very significant. Analyzing the early production of the five cultivars covered with Agril film with a density of 30 g/m², it is found that only two varieties exceeded the average production of the 5 cultivars, namely, Dorée de prentemps, with a production increase of 19.2% and Jester with a 48.1% increase. The differences compared to the control were

CONCLUSIONS

Research on the influence of cultivar and microporous films in organic vegetable microfarm in NW of Romania highlighted several important aspects, namely:

1. The production of lettuce grown in solariums is influenced by the lettuce variety chosen, thus the Jester variety obtained a production of 2.77 kg/m², while the Lollo rossa variety only 0.93 kg/m².
2. Both the microporous film with a density of 17 g/m² and the one with a density of 30 g/m² positively influenced early production in all cultivars studied, the one with a density of 30 g/m² even more significantly.
3. The Jester variety, covered with microporous foil with a density of 30 g/m², recorded the highest absolute production (3.43 kg/m²), 1.25 kg/m² more than the control.
4. The Lolo rossa variety is highly appreciated by consumers due to the appearance and fineness of its leaves. It obtained the lowest

provided with a statistically distinct significant in the case of the Dorée de prentemps variety, respectively, very significant in the Jester variety.

Although pest prevention and control was not a research objective, it was observed that agril foils also have an effect on reducing aphid populations.

production compared to the other varieties, including the control, but the protective foils positively influenced production, with 0.27 kg/m² for the less dense foil, respectively 0.48 kg/m² in the case of covering with the 30 g/m² foil, compared to the uncoated variant.

5. The Dorée de prentemps variety also performed well. It recorded a higher production than the control, without foil, but especially in the case of covering with foil with a density of 30 g/m², when the difference from the control was ensured to be statistically distinctly significant.

6. Even though the Tuareg variety reacts well to lower temperatures, the protective film, especially the higher density one, influenced the early production of heads.

7. Microporous films intended for protection against low temperatures have as a secondary effect the reduction of insect populations harmful to the lettuce.

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