

MULCHING AND FERTILIZATION AS MAIN TECHNOLOGICAL MEANS USED FOR AN ORGANIC BROCCOLI CROP

MULCIREA ȘI FERTILIZAREA CA PRINCIPAL MIJLOC TEHNOLOGIC ÎNTR-O CULTURĂ ORGANICĂ DE BROCCOLI

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Abstract. *The purpose of the present paper is to evaluate the influence of mulching and fertilization on an early broccoli crop grown according to organic farming norms. The research was carried out in the experimental field of the Agronomic University of Iași, Romania. In the bifactorial experiment, the influence of mulching with three graduations was tested - unmulched-Ct, mulching with polyethylene foil of 15 and 30 microns thick, as well as the fertilization with three graduations - unfertilized-Mt, organic fertilization and application of microorganisms, under the conditions of the years 2018 and 2019. The culture was established from seedlings of 42 days, in strips of 2 rows each, the distance between strips being of 80 cm and between rows of 60 cm. The distance between plants was of 25 cm, resulting in a density of about 57 thousand plants per hectare. The obtained results indicate increases in the yield, in the case of the mulched and organically fertilized variants, the best yields being obtained in the case of the mulched variant with 30 microns foil and organically fertilized with Orgevit.*

Key words: technological factors, yields, chlorophyll pigments.

Rezumat. *Scopul prezentei lucrări este de a evalua influența mulcirii și a fertilizării la o cultură timpurie de broccoli cultivată conform normelor de agricultură ecologică. Cercetările au fost efectuate în câmpul experimental al Universității Agronomice din Iași, România. În cadrul experienței bifactoriale, a fost testată influența mulcirii cu trei graduări – nemulcit-Mt, mulcire cu folie de polietilenă de 15 și 30 microni grosime și a fertilizării cu trei graduări – nefertilizat-Mt, fertilizare organică și aplicare de microorganisme, în condițiile anilor 2018 și 2019. Cultura a fost înființată prin răsad de 42 de zile, în benzi de câte 2 rânduri, distanța dintre benzi fiind de 80 cm, iar dintre rânduri de 60 cm. Distanța dintre plante a fost de 25 cm rezultând o densitate de aproximativ 57 mii plante/hectar. Rezultatele obținute indică creșteri ale producțiilor în cazul variantele mulcite și fertilizate ecologic, producțiile cele mai bune fiind obținute în cazul variantei mulcite cu folie de 30 microni și fertilizată organic cu Orgevit.*

Cuvinte cheie: factori tehnologici, producții, pigmenți clorofilieni.

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INTRODUCTION

Mulching and fertilization are two important technological links that significantly place their mark on the establishment of an early broccoli crop, managed according to the organic farming norms (Stan, 2010; Stoleru *et al.*, 2014).

Soil mulching in the organic farming system is one of the research topics targeted at an international level, because it has special implications both on the quantity, quality and precocity of the yield, and on the physical and chemical properties of the soil, the activity of soil microorganisms, most of them having a beneficial role, which give mulched lands the characteristic of sustainability. In addition to the obvious advantages, mulching also has some disadvantages, such as the creation of a barrier for oxygen and water, and the creation of differences between soil temperature and that of the environment (Teliban *et al.*, 2018; Caruso *et al.*, 2019a).

The success of an early broccoli crop, managed according to organic farming principles, also depends on the adequate supply of water and nutrients (Babik and Elkner, 2002; De Oliveira *et al.*, 2016). The fertilization can be carried out with different types of organic fertilizers (manure, compost - these are commonly used in organic vegetable crop practice), but lately the research is aimed at applying different microorganisms with the role of increasing the microbiological activity of the soil, determining the growth and intense development of the plants (Caruso *et al.*, 2019b; Lu *et al.*, 2018).

In these circumstances, the purpose of the present research is to evaluate the influence of mulching and fertilization on the early broccoli crop grown in the organic farming system.

MATERIALS AND METHOD

The research was organized under the experimental conditions of the 2018 and 2019 years, at the Experimental Station of the Agronomic University of Iasi. The experiment was carried out on a soil of the medium leached chernozem type, with an average content of nutrients, with 3% organic matter and a 6.5 pH. The weather conditions from the experimental period were favorable for this crop.

The experimental protocol dictated the organization of a bifactorial experiment, organized in a split plot design, with three repetitions (fig. 1). The influence of the two experimental factors was studied in the open field using an early broccoli hybrid - Brontolo - recommended for an early crop (<https://seminte-ingrasaminteturba.ro/product/broccoli-brontolo-f1/>):

Factor A – mulching application with three graduations: a_1 = unmulched (Unmulch), mulched with a standard black light density polyethylene film, 15 μm and 30 μm in thickness (a_2 = LDPE 15 μm and a_3 = LDPE 30 μm);

Factor B – three graduations of fertilization: b_1 = unfertilized variant (Unfert), b_2 = organic fertilization with Orgevit® (O) and b_3 = application of microorganisms, Micoseeds MB® (M).

In both experimental years, the crop was established by using seedlings of 42 days, on April 10th, in strips of two rows each, at 80 cm distance between strips and 60 cm between rows. The distance between the plants in a row was of 25 cm,

resulting in a density of about 57 thousand plants/hectare (Popescu and Zăvoianu, 2011). The work carried out during the vegetation period was according to the specialized literature (Stan and Munteanu, 2001; Zăvoianu, 2010; Togănel, 2013) and consisted of irrigation (done by dripping), weeding (manually) and two fertilizer application. The first round of fertilization was done before planting - the starter fertilization, with 200 kg Orgevit and 60 kg Microseeds MB, respectively. The second round of fertilization, the root-phase fertilization, was applied three weeks after planting, using the same fertilizer doses.

The performance of experimental variants was assessed by evaluating the yield (kg/ha) and the total chlorophyll pigments content (CCI - Chlorophyll Content Index). The harvest was done at the proper commercial stage and the chlorophyll contents were achieved before harvesting, by using the CCM-200 plus (Chlorophyll Content Meter).

The experimental data was processed by appropriate statistical-mathematical methods (Jitareanu, 1999; Leonte and Simioniuc, 2018). The least significant differences (LSD) test was used for the yields, and the Anova test for the chlorophyll content.



Fig. 1 Aspects from the broccoli experiment

RESULTS AND DISCUSSIONS

A. Influences on the yield

The results obtained regarding the influence of mulching on the early broccoli crop yield, for the Brontolo hybrid, are presented in table 1.

From the presented data it is observed that the best results were obtained in the case of mulching with 30 microns foil (17658.8 kg/ha), with an yield increase

of 2607.1 kg/ha (17.32%), compared to the unmulched control (15051.7 kg/ha), this difference being statistically significant, while the variant mulched with 15 microns foil recorded an yield of 16714.8 kg/ha, with an yield increase of 1663.1 kg/ha (11.05%) compared to the control variant, the increase registered being considered significant.

Table 1

Results obtained regarding the influence of mulching on the broccoli yield

No. crt.	Mulch type	Yield			Difference significance
		kg/ha	% compared to the Control	Difference compared to the Control	
1.	Unmulch	15051.7	100.00	0.0	Ct
2.	LDPE 15 μ m	16714.8	111.05	1663.1	*
3.	LDPE 30 μ m	17658.8	117.32	2607.1	**

DL 5% = 1398.3 kg/ha; DL 1% = 2318.7 kg/ha; DL 0,1% = 4330.6 kg/ha

Regarding the influence of fertilization on the early broccoli yield (table 2), the highest yield was obtained in the case of the variant organically fertilized with Orgevit (18241.4 kg/ha), the yield increase of 3508.8 kg/ha (23.82%) compared to the unfertilized version (Control) being considered very significant. The variants fertilized with microorganisms also registered yield increases (Microseeds MB), but they were of 1718.5 kg/ha (11.66%), being considered significant compared to the unfertilized variant (14732.6 kg/ha).

Table 2

Results obtained regarding the influence of fertilization on the broccoli yield

No. crt.	Treatment	Yield			Difference significance
		kg/ha	% compared to the Control	Difference compared to the Control	
1.	Unfert	14732.6	100.00	0.0	Ct
2.	O	18241.4	123.82	3508.8	***
3.	M	16451.1	111.66	1718.5	*

DL 5% = 1246.2 kg/ha; DL 1% = 1749.3 kg/ha; DL 0,1% = 2469.5 kg/ha

Regarding the combined influence of the two experimental factors studied, mulching x fertilization (table 3), the results highlight the positive influence of the two experimental factors on the early broccoli crop yield, all the combinations between mulching and fertilization generating statistically supported yield increases. The best combinations, with very significant positive differences compared to the unmulched x unfertilized control of the experiment, resulted into the variants LDPE 30 μ m x O, LDPE 15 μ m x O and LDPE 30 μ m x M, which provided increases of 51.45%, 42.86% and 35.79% respectively.

Results regarding the influence of the mulching x fertilization combination on the broccoli yield

No. crt.	Variant	Yield			Difference significance
		kg/ha	% compared to the Ct	Difference compared to the Ct	
1.	Unmulch x Unfert	12915.3	100.00	0.0	Ct
2.	Unmulch x O	16713.7	129.41	3798.4	**
3.	Unmulch x M	15526.0	120.21	2610.7	*
4.	LDPE 15 μ m x Unfert	15404.3	119.27	2489.0	*
5.	LDPE 15 μ m x O	18450.3	142.86	5535.0	***
6.	LDPE 15 μ m x M	16289.7	126.13	3374.4	**
7.	LDPE 30 μ m x Unfert	15878.3	122.94	2963.0	*
8.	LDPE 30 μ m x O	19560.3	151.45	6645.0	***
9.	LDPE 30 μ m x M	17537.7	135.79	4622.4	***

DL 5% = 2158.5 kg/ha; DL 1% = 3029.8 kg/ha; DL 0,1% = 4277.4 kg/ha

B. Influences on the chlorophyll content

The content of chlorophyll pigments recorded in the early broccoli crop grown according to organic farming standards are shown in Figure 2. The chlorophyll content index (CCI) ranged from 82.3 CCI (Unmulch x Unfert) to 97.7 CCI (LDPE 30 μ m x O), the differences between these two variants being significant, according to the Anova test. There were no significant differences recorded between the other variants, according to the same test.

Although the minimum and maximum value of the CCI is correlated with the lowest and the highest yield respectively, for the other variants there is no direct correlation between the CCI value and the yields produced.

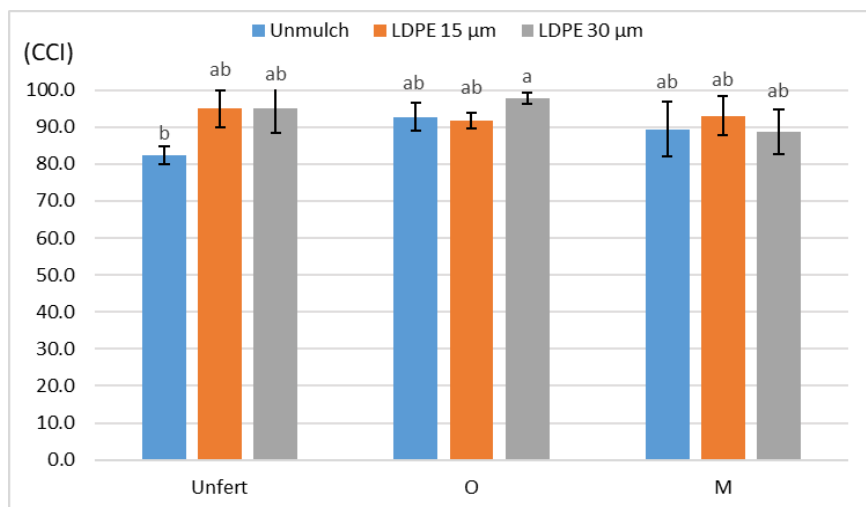


Fig. 2 Results regarding the chlorophyll pigments content in the early broccoli crop

CONCLUSIONS

1. Mulching and fertilization determine important increases in the early broccoli crop yields, the organic fertilization with Orgevit causing very significant positive differences, compared to the unfertilized variant.

2. The combined influence of the two experimental factors, mulching x fertilization, reveals the highest yield in the case of the LDPE 30 μm x O variant - 19560.3 kg/ha.

3. The content of chlorophyll pigments is partially correlated with the yields obtained, significant differences resulting only between the variants of Unmulch x Unfert and LDPE 30 μm x O.

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