VARIATION OF YIELD AND FRUIT QUALITY OF EGGPLANT DEPENDING ON SOIL MULCHING

VARIAȚIA CANTITĂȚII ȘI CALITĂȚII FRUCTELOR DE PĂTLĂGELE VINETE ÎN FUNCȚIE DE MULCIREA SOLULUI

CONSTANTIN Delia – Cristina [1]*, PARASCHIV Mihaela [1], SBÎRCIOG Gicuța[1], BUZATU Mihaela – Alina[1]

*Corresponding author e-mail: mihaela2mail@yahoo.com

Abstract.
Soil mulching has a significant influence on yield and fruit quality of vegetables. The present work aimed to determine the influence of some types of mulch on some production and quality parameters of eggplant fruits. Four types of plastic film were used: transparent, black, black-white and brown mulching film, and as organic material, straw mixed with tree bark. The five mulching variants were compared both with each other and with the variant in which soil mulching was not practiced. The open-pollinated cultivar Luiza was used as biological material. Yield potential was determined by the number of fruits per plant, the average weight of a fruit and the yield per hectare. Fruit quality was determined by the content of total dry matter, water content and total soluble solids. The practice of soil mulching had a significant influence on yield and fruit quality of eggplant. Of the variants studied, the best results were obtained in the case of usage of the black and brown foil mulching variants.
Key words: fruit quality, mulching film, organic mulching, yield

Rezumat.
Mulcirea solului are o influență semnificativă asupra producției și calității legumelor. Prezenta lucrare a avut ca scop determinarea influenței unor tipuri de mulci asupra unor parametri de producție și de calitate la fructele de pătlăgele vinete. Au fost utilizate patru tipuri de folie din plastic: folie transparentă, folie neagră, folie albă-neagră și folie maro, iar ca material organic, paie amestecate cu scoarță de copac. Cele cinci variante de mulcire au fost comparate atât între ele, cât și cu varianta în care nu a fost practicată mulcirea solului. Ca material biologic, a fost utilizat cultivarul cu polenizare liberă Luiza. Potențialul de producție a fost determinat prin numărul de fructe pe plantă, masa medie a unui fruct și producția la hectar. Calitatea fructelor a fost evaluată prin conținutul de substanță uscată totală, de apa și totalul solidelor solubile. Practicarea mulcirii solului a avut o influență semnificativă asupra producției și calității fructelor de pătlăgele vinete. Dintre variantele studiate, cele mai bune rezultate au fost obținute în cazul mulcirii cu folie neagră și maro.

[1] Research and Development Institute for Vegetable and Flower Growing Vidra

Cuvinte cheie: calitatea fructelor, folie de mulcire, mulcire organică, producție

INTRODUCTION

Soil mulching has become an important soil preparation work in vegetable crop, with a significant impact on fruit production and quality. Basically, mulch plays an important role in the microclimate created around plants, with an impact both into and out to the soil (Ciofu et al., 2004, Tarara, 2000). The work of mulching the soil involves covering it with various organic or inorganic materials. (Ciofu et al., 2004; Kader et al., 2017). Plastic film mulching is preferred for large areas, due to the low costs compared to the profit obtained (Mugalla et al., 1996).

Mulching has a very strong impact on the soil. The most important effect is the influence on soil moisture, which is retained for a longer period of time (Patil et al., 2013). Thus, the consumption of water used for crop irrigation can be reduced (Kader et al., 2019). Regarding soil temperature, the type of mulch has a significant effect (Choudhary et al., 2022; Kader et al., 2017). Some types of mulch, such as black polyethylene film, keep soil temperatures higher, while applying organic mulch generally leads to a cooler of soil (Kader et al., 2017). Also at the soil level, mulching has a significant impact on some soil diseases, in the case of some, decreasing the incidence, and in the case of others, increasing it (Ngosong et al., 2019). Another positive aspect is its role in weed control (Choudhary et al., 2022). Also, several studies have shown that the application of mulch on soil surfaces and the use of drip irrigation systems can enhance nitrogen uptake efficiency by plants (Vázquez et al., 2006). Depending on its nature and colour, mulch influences the light spectrum in the immediate vicinity of the plants, with a potential effect on fruit ripening (Kaul and Kasperbauer, 1992).

Eggplant are a vegetable species with high requirements for heat and humidity (Munteanu, 2003). In the case of eggplant, studies have shown that soil mulching has a positive effect on fruit yield, but the effect varies depending on the type of foil (Adamczewska-Sowińska et al., 2016). Some studies indicate that transparent plastic film increased eggplant yield (Ahmed et al., 2016), but a similar response may also occur when using black polyethylene film (Adamczewska-Sowińska et al., 2016). Also in eggplant, it was observed that fruit yield is higher in mulched soil, compared to un-mulched soil, in the case of a water deficit. (Abdrabbo et al., 2017).

The present research aims to determine the impact of soil mulching with different types of plastic or organic materials on the yield and quality of eggplant fruits.

MATERIAL AND METHOD

The present experiment was carried out in the research field of the Research and Development Institute for Vegetable and Flower Growing Vidra, Ilfov county, during the period May - September 2025.

The biological material consisted of Luiza eggplant seedlings, produced in greenhouses within the institute. It was produced in alveolar pallets, from Luiza seed obtained in 2023, "Base" category.

The land was prepared prior to planting. The land was parcelled out to delimit the experimental plots. Each plot was 15 m long and 1.4 m wide, with an area of 21 m^2. All experimental variants were drip irrigated. Soil mulching was performed according to the experimental variants studied, thus:

V1 = un-mulched ground;
V2 = mulching with black plastic film;
V3 = mulching with transparent plastic film;
V4 = mulching with white-black plastic film;
V5 = mulching with brown plastic film;
V6 = mulching with straw mixed with tree bark.

The 6 variants studied were arranged randomly, in three replications.

The planting of seedlings in the field was carried out on 23^{th} of May, 2024. The distance between rows was 70 cm, and the distance between plants was 40 cm, resulting in a density of 35000 plants/ha.

Throughout the vegetation phase, crop maintenance works were carried out, as well as throughout the experimental field. Two manual and two mechanized weedings were carried out. Phytosanitary treatments were applied depending on the needs of the plants and the environmental conditions, having a preventive character. Irrigation was carried out with a watering rate of 45-55 m^3/ha, at an interval of three days. All variants were watered in the same way, at the same time, even if the un-mulched variant lost soil moisture faster.

The fruit were harvested manually. Three harvests were carried out, the first when 20% of the fruit reached technological maturity. At harvest, the number of fruits/plant, average weight of a fruit and yield/ha were determined.

At harvest, the percentage of fruit affected by blossom end rot was also determined, but these fruits were not used in determining production yield.

From the harvested fruits, 20 fruits were randomly selected and the total dry matter content, water content and total soluble solids were determined in the laboratory.

The dry matter and water content and of the fruit pulp were expressed as percentages. These parameters were determined using the gravimetric method, by drying 10 g of sample in an oven at 105°C until a constant weight was achieved (Krełowska-Kułas, 1993). The total soluble solids (TSS) content was measured using a refractometer and expressed in °Brix (PN-90/A-75101/02). Ash content was determined by calcining the samples at 450°C for 48 hours, and the results were expressed as a percentage of the fresh weight (% FW) (Horwitz, 2000).

Statistical analyses were conducted using SPSS software, version 20.0 (SPSS Inc., Chicago, IL, USA). Data are expressed as mean ± standard error. Group comparisons were evaluated using one-way analysis of variance (ANOVA). $P < 0.05$ was considered indicative of statistical significance.

RESULTS AND DISCUSSIONS

Table 1 presents the effect determined by soil mulching on some parameters regarding eggplant production, from the point of view of the ANOVA test.

Table 1

The effect of mulching variant on some productivity parameters at eggplant, Luiza cultivar

Evaluated component		Number of fruits/plant	Fruit weight (g)	Fruit yield (t/ha)	Fruit affected by BER (%)
Mulching technique	Sig.	* (p=0.049)	* (p=0.048)	*** (p=0.000)	*** (p=0.000)
	Effect size	60.3	60.9	83.8	85.7

BER = blossom end rot. Significance letters and symbols refer to treatment effects. n.s. = non-significant; * = significant (p ≤ 0.05); ** = highly significant (p ≤ 0.01); *** = very significant (p ≤ 0.001).

The data presented in the table indicate that both the number of fruits/ plant and the average fruit weight (g) in eggplant were significantly influenced by the soil mulching techniques applied, with effect sizes of 60.3% and 60.9%, respectively. Also, the mulching of the soil had a very significant influence on both the fruit yield (t/ha) (effect size of 83.8%) and the fruits affected by blossom end rot (BER) (with an effect size of 85.7%).

Table 2 shows the effect of soil mulching on some quality parameters of eggplant fruits.

Table 2

The effect of mulching variant on some quality parameters of eggplant fruits, Luiza cultivar

Evaluated component		TSS (% Brix)	DW (%)	Ash (%)
Mulching technique	Sig.	*** (p=0.000)	* (p=0.032)	n.s. (p=0.078)
	Effect size	85.4	60.1	27.8

TSS = Total soluble solids; DW = dry matter content. Significance letters and symbols refer to treatment effects. n.s. = non-significant; * = significant (p ≤ 0.05); ** = highly significant (p ≤ 0.01); *** = very significant (p ≤ 0.001).

From the presented data it can be seen that some of the quality parameters were influenced by the soil mulching variants, from the point of view of the ANOVA test. The mulching work had a very significant effect on some parameters such as total soluble solids and significantly effect on dry matter content. However, the ash content was not influenced by the factor studied.

Table 3 presents some statistical descriptors such as mean, median, standard deviation coefficient of variation minimum and maximum, for some parameters regarding the production of eggplant, cultivar Luiza.

Table 3

Statistical descriptors (mean, median, standard deviation, coefficient of variation, minimum, and maximum) for the productivity parameters, at Luiza eggplant cultivar

Statistical descriptors	Number of fruits/plant	Fruit weight (g)	Fruit yield (t/ha)	Fruit affected by BER (%)
Mean	3.71	308.91	39.20	5.43

Median	3.60	318.59	38.99	5.07
Std. deviation	0.61	51.69	3.47	2.11
Var. coeff.	0.165	0.167	0.089	0.389
Minimum	2.53	217.50	33.29	1.67
Maximum	4.68	409.08	45.32	9.29

BER = Blossom end rot

The average values presented in Table 3 indicate that the plants produced, on average, 3.71 fruits, with an average weight of 308.91 g, which led to an average production of 39.20 t/ha. The proportion of fruits affected by blossom end rot (BER) was relatively low (5.43%). Comparing the mean with the median shows close values for most of the analysed indicators. The standard deviations highlight the absolute variability of the characters. Thus, the fruit weight shows a greater variation (±51.69 g) compared to the production (±3.47 t/ha), while the number of fruits/plant has a lower variability (±0.61). In contrast, the percentage of fruits affected by BER has a standard deviation of 2.11, suggesting notable differences between observations. At the same time, in the case of fruits affected by this metabolic defect, the higher coefficient of variation (0.389) suggests a high variability and an increased sensitivity to environmental or technological factors. The intervals between the minimum and maximum values highlight the amplitude of the variation. For example, the fruit weight varies between 217.50 g and 409.08 g, and the production between 33.29 and 45.32 t/ha, which reflects considerable differences between the experimental units. In the case of BER, the values vary between 1.67% and 9.29%, confirming the unstable nature of this parameter.

In table 4 are presented some statistical descriptors such as mean, median, standard deviation coefficient of variation minimum and maximum, for some quality parameters of eggplant fruits, Luiza cultivar.

The standard deviations highlight the absolute variability of the analysed characters. Dry matter (±1.27) presents the highest variation, followed by TSS (±0.51), while ash content has a very low variability (±0.02), which indicates a high stability of this parameter. The coefficient of variation confirms these trends. Thus, DW presents a moderate variability (0.161), and TSS a relatively low variability (0.119). In contrast, ash content has a very low coefficient of variation (0.033), highlighting a very good uniformity of this character within the analysed samples. The minimum and maximum values indicate the amplitude of variation for each parameter. TSS varies between 3.53 and 5.01% Brix, and DW between 5.68% and 9.96%, which reflects moderate differences between samples. In the case of ash content, the range is very narrow (0.47–0.53%), confirming the stability of this indicator.

Table 4

Statistical descriptors (mean, median, standard deviation, coefficient of variation, minimum, and maximum) for some quality parameters of eggplant fruits, at Luiza cultivar

Statistical descriptors	TSS (% Brix)	DW (%)	Ash (%)
Mean	4.30	7.90	0.49

Median	4.27	7.77	0.50
Std. deviation	0.51	1.27	0.02
Var. coeff.	0.119	0.161	0.033
Minimum	3.53	5.68	0.47
Maximum	5.01	9.96	0.53

In Table 5, data on the influence of soil mulching on some parameters regarding eggplant yield can be observed. It can be seen that there are significant differences between the studied variants in terms of the production parameters monitored.

Table 5

Results on the influence of mulching options on fruit production

Variant	Variant description	Number of fruits/plant	Fruit weight (*g*)	Fruit yield (t/ha)	Fruit affected by BER (%)
V1	Un-mulched ground	3.96±0.71 a	254.87±60.14 b	34.31±1.17 d	8.88±0.53 a
V2	black plastic mulch film	3.62±0.50 ab	328.90±30.71 ab	41.31±1.83 ab	4.43±1.13 cd
V3	transparent plastic mulch film	3.50±0.27 ab	315.98±19.11 ab	38.65±0.99 bc	4.16±0.65 cd
V4	white-black plastic mulch film	4.37±0.33 a	264.64±23.82 b	40.42±2.93 b	6.62±0.99 b
V5	brown plastic mulch film	3.88±0.58 a	327.76±53.27 ab	43.78±1.39 a	5.49±0.96 bc
V6	straw with tree bark mulch	2.93±0.36 b	361.30±41.67 a	36.71±0.63 cd	3.03±1.24 d

BER = Blossom end rot. Values followed by different letters within each column are significantly different based on Duncan multiple range test ($P \leq 0.05$).

The number of fruits per plant varied significantly with values ranging from a minimum of 2.93 fruits/plant (straw with tree bark mulch) to a maximum of 4.37 fruits/plant (white-black plastic mulch film). It is observed that in the case of usage of organic mulch with straw with tree bark, a significantly lower number of fruits is obtained, compared to the mulching variants with white-black and brown plastic mulch film, but also compared to the un-mulched variant.

Regarding **fruit weight**, this parameter varied significantly with values ranging from 254.87 g (un-mulched ground) to 361.30 g (straw with tree bark mulch). The use of organic mulch led to significantly larger fruits, compared to the variant in which no type of mulch was applied, but also compared to the white-black plastic film.

Regarding the effect of organic mulch, it is observed that, although the number of fruits per plant is lower, their size has increased. The plants used the resources to increase the size of the fruits. The white-black plastic mulch film had presented an opposite effect on fruit number and weight. Although it produced the most fruit per plant, the fruit were significantly smaller, compared to the organic mulch.

Fruit yield varied significantly with values ranging from a minimum of 34.31 t/ha (unmulched ground) to 43.78 t/ha (brown plastic mulch film). Most of the mulched variants led to a significant increase in production, compared to the option in which the mulching work was not carried out. The highest production was obtained in the case of brown foil (43.78 t/ha), followed by black foil (41.31 t/ha), between the two variants there being no significant differences. In the case of these two variants, the high production was explained both by the number of fruits per plant (between 3.62-3.88 fruits/plant), and the weight of the fruits (327.76-328.9 g).

In the case of white-black mulch film, the yield (40.42 t/ha) was significantly higher than that obtained in the case of no mulch or the case in which organic mulch from a mixture of straw and tree bark was used. However, this variant was significantly weaker than the variant in which brown plastic mulch was used.

In the case of transparent foil, although the yield was significantly higher compared to the un-mulched version, it did not present the highest production value, as was the case in other studies (Ahmed et al., 2016). However, the results were comparable to other studies, which indicate that there are no significant differences in fruit yield between transparent and black mulch film (Adamczewska-Sowińska et al., 2016).

The yield did not differ significantly in the case of straw and bark mulch, compared to the variant in which the soil was not mulched.

At the same time, the percentage of fruits affected by blossom end rot was determined. All mulching variants determined a significant decrease in the percentage of fruits affected compared to the variant without mulch. This variant led to a percentage of 8.88% of fruits affected by blossom end rot. At the opposite pole, the variant in which organic mulching with straw and bark was used. Black and transparent films led to a percentage of 4.16-4.43% of affected fruits. Although it led to the highest fruit production, the variant in which brown film was used led to a fairly high percentage of fruits affected by blossom end rot, but it remains, however, significantly lower compared to the variant in which soil mulching was not practiced.

Table 6 illustrates the data on the results regarding the influence of mulching variants on some fruit quality parameters.

Table 6

Results on the influence of mulching options on fruit quality

Variant	Variant description	TSS (% Brix)	DW (%)	Ash (%)
V1	unmulched ground	3.78±0.07 c	7.42±0.60 bc	0.49±0.20 a
V2	black plastic mulch film	4.82±0.19 a	9.04±0.30 ab	0.50±0.02 a
V3	transparent plastic mulch film	3.70±0.21 c	7.13±0.91 c	0.49±0.02 a
V4	white-black plastic mulch film	4.90±0.08 a	9.38±0.63 a	0.51±0.20 a

V5	brown plastic mulch film	4.26±0.45 b	7.57±0.83 bc	0.49±0.01 a
V6	straw with tree bark mulch	4.34±0.19 b	6.86±1.77 c	0.48±0.01 a

TSS = Total soluble solids; DW = dry matter content. Values followed by different letters within each column are significantly different based on Duncan multiple range test (P≤0.05).

The total soluble solids content varied significantly in eggplants, depending on the mulching options applied, with average values ranging from a minimum of 3.70%Brix (transparent plastic mulch film) to a maximum of 4.90%Brix (white-black plastic mulch film). The highest values were obtained in the case of the white-black foil mulching options, followed by the black foil mulching option. The brown foil mulching options and the straw-bark mixture mulching options had significantly lower TSS values compared to the white-black or black foil mulching options, but significantly higher compared to the plastic foil mulching options and the transparent foil mulching option. In the case of the brown foil, the total soluble solids content had an average value of 4.26%Brix, and in the case of the straw-bark mixture, of 4.34% Brix.

CONCLUSIONS

Growing eggplant on un-mulched soil or on black and white foil led to an increase in the number of fruits per plant, but with a significantly smaller size. On the other hand, mulching with organic materials decreased the number of fruits per plant, but greatly increased their weight.

The yield was significantly higher in the case of plastic foil compared to the un-mulched version, with maximum effect in the case of brown foil.

Mulching the soil significantly reduced the percentage of fruit affected by blossom end rot.

Total soluble solids content and dry matter content were maximum in the case of soil mulching with black and white-black foil.

The ash content was not significantly influenced.

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