
DOCTORAL THESIS

Research on the influence of some technological factors on the production of eggplants grown in different systems

(SUMMARY OF THE DOCTORATE THESIS)

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INTRODUCTION

In a period when it is necessary to increase the production, the consumption of fresh vegetables and in order to ensure safe agri-food products for human consumption, through the research of the topic addressed, it will contribute to the improvement of the technology of cultivating eggplants in the field comparing the ecological system to the conventional one. This will result in the increase of the quantitative and qualitative level of the production.

Eggplants are one of the vegetable species grown in our country. Thus, in the experimental cultures carried out in the western part of Romania, several varieties were studied that were cultivated in the conventional and the ecological system. The most productive was investigated the influence of different decimals on the way of growth and development of the plants and the production achieved.

STRUCTURE OF THE DOCTORAL THESIS

The doctoral thesis is structured in two parts (Part I – Current State of Knowledge and Part II – Personal Contribution) and comprises 9 chapters. The doctoral thesis has 142 pages (including 19 figures and 80 tables), plus Bibliography and abstracts in Romanian and English. The bibliography contains 125 bibliographic sources (treatises, books, scientific articles, websites).

CURRENT STATE OF KNOWLEDGE

The documentary part was structured in three chapters. In **Chapter 1 - The evolution and importance of the eggplant culture** were addressed problems related to the origin and the spreading area, the situation of the eggplant culture worldwide and in Romania, the importance of the eggplant in food as well as the therapeutic importance of the eggplant. In **Chapter 2- The bio-ecological characteristics of the eggplants in relation to the quantitative and qualitative production**, problems related to the botanical and biological particularities of the eggplants and the ecophysiological requirements were addressed. In **Chap. 3-The peculiarities of the eggplant culture technology in the field** have identified the current problems regarding the specificity of the conventional eggplant technology (crop rotation, soil preparation, crop establishment, maintenance work, harvesting, conditioning and storage of eggplants), the specificity of ecological eggplant cultivation technology (soil preparation, fertilization specific, crop establishment, weed control diseases and pests through ecological methods).

PERSONAL CONTRIBUTION

The objectives pursued. The general objective was to establish technological elements that improve the quantitative and qualitative parameters, as well as the possibilities of cultivating the eggplant in the ecological system, compared to the conventional culture system. The ecological system of eggplant culture ensures superior quality products, without pesticide residues, being demanded by consumers in increasing quantities. Because the production of vegetables in the ecological system must ensure economic profitability, it is necessary to obtain quantitative and qualitative productions that will cover the additional expenses necessary for the production process.

The purpose of the research is the provision of data additional to those known in the productive practice for the two culture systems (conventional and ecological), in order to achieve superior productions from a quantitative and qualitative point of view. In the carried out researches, the influence of some technological factors on the growth of the plants, as well as on the quantitative and qualitative production of eggplants, carried out in the pedoclimatic conditions specific to the western area of Romania was pursued.

Study on the influence of culture on plant growth and production, on eggplant culture performed in different systems - In a comparative experience, it was followed the growth of eggplant plants, the quantitative and qualitative production, in 10 varieties of eggplant, cultivated in different systems (culture conventional and organic culture).

Study on the influence of plant sowing on plant growth and production, in some eggplant crops - The growth of the mangrove plants, the quantitative and qualitative production, was followed in seven varieties of eggplant in conventional culture compared to the ecological one, using three variants of decimals. This being achieved by ensuring different distances between plants. By increasing the number of plants at the surface unit, the volume of production at the surface unit can be favorably influenced.

Particularities of the natural environment in which the experimentation took place. The experiences took place in a private vegetable microfarm in the town of Husasau de Tinca, Bihor County, 36 km from Oradea, on the Mersig plain. This locality is located in the northwestern part of Romania, in the Western Plain, on the county road that connects Oradea municipality with Arad county. It is also in contact with the Western Piedmont Hills and hidden between the hills on a low area. The commune of Husasau de Tinca has a total area of 117 km², placing it among the largest communes in Bihor county.

Biological material. In 2017, 10 varieties of eggplants were used, and in 2018-2019 only 7: *Zaraza, Violetta di Firenze, Carina, Black Beauty, Japanese Pickling, Dourga, Orange de Turquie, Monstrueuse de New York, Listada Da Gandia, Jilo Tingua Verde*.

Organizing experiences.

Experience I - The influence of the variety and the culture system on the eggplants grown in the field was organized in 2017, was of a bifactorial type, having the following experimental factors:

- Factor A, the cultivar with 10 graduations: a₁- Zaraza, a₂- Violetta di Firenze, at₃- Carina, at₄- Black Beauty, at₅- Japanese Pickling, at₆- Dourga, at₇-

Orange de Turquie, at₈- Monstrueuse de New York, at₉- Listed Da Gandia, at₁₀- Jilo Tingua Verde;

- Factor B, the culture system with 2 graduations: b₁, b₂—ecological-conventional).

From the combination of the experimental factors resulted in 20 experimental variants, which were placed on 1 m wide foil, with the distance between plants at 0.5 m row. The experimental variants were placed in three repetitions. The surface of a variant plot is 3.0 m² (180 m² / experience).

Experience II - Infusion of the variety and planting of the plant varieties in the field, in different systems was carried out in the period 2018-2019, being of a trifactorial type with the following experimental factors:

- Factor A, culture with 7 graduations: a₁- Zaraza, a₂- Violetta di Firenze, a₃- Black Beauty, a₄- Japanese Pickling, a₅- Dourga, a₆- Monstrueuse de New York, a₇- Listed Da Gandia;
- Factor B, plant size, with 3 graduations: b₁-34.6 thousand plants / ha, b₂- 45.5 thousand plants / ha, b₃- 60.6 thousand plants / ha.
- Factor C, the culture system, with 2 graduations: c₁ .conventional system, c₂ .ecological system.

42 experimental variants resulted from the combination of the experimental factors, which were placed on two rows. On a sheet of 1.20 m wide, with the distance between rows per sheet of 0.70 m and between plants per row of 0.50 m; 0.40 m and 0.30 m, to achieve the three decimals established by the experimental protocol. The experimental variants were placed in three repetitions, the surface of a variant plot being 3.0 m² (380 m² / experience).

The culture technology applied in the experimental cultures. In the experimental culture in the plot with conventional culture system the pre-plants were carrot and parsley, and in the ecological plot the green beans. The distance between the two plots is 50 m. In the autumn of 2016, on all the experimental plots, semi-compound manure was obtained, coming from a traditional household, in an amount of 45 t / ha. The seedlings were produced according to conventional and ecological technology. It was sown on 04.03.2017, the reticle was made in nutritional pots of 9.5x9.5x9.5. Previcur was used as seed treatments for the classic version and for the organic nettle macerated.

The planting was done on a black polyethylene film with a width of 1 m, and below the drip watering strips were put in advance. After planting a watering was done to ensure the catch, and during the vegetation watering was done whenever it was needed. After planting for the prevention of vascular diseases (*Fusarium* and *Verticillium*) a soil treatment with Topsin was done in the conventional plot, and at the ecological one a mixture of horseradish macerate and nettle macerate was used.

Phase fertilization was done in 3 rounds. In the conventional version using complex fertilizers, and in the ecological version was used in the first fertilization Agriful. At the other bird litter. In the conventional culture for Antracnoza there was a treatment with Antracol, and in the ecological culture there were 2 foliar treatments with nettle macerate and horse tail. For pests in the conventional plot Milbeknock was used for mites, Kalipso and Actara for the Colorado cockroach. Garlic extract was used for the mites and Laser for the Colorado Cockroach.

The culture technology from 2018 and 2019, was very similar to the one from 2017, but with some differences. The distance between the two plots was 60 m. The preliminary plant was green beans in the conventional plot, and the cucumber in the organic plot.

It was seeded on 03/03/2018 respectively 05.03.2019. The Reped was made in nutritional pots, and as a treatment for seedlings Previcur was used for the classic version and macerated nettle for the ecological one. The planting was made on a mulch of black color with a width of 1.20 m, and below it were placed drip watering strips. In order to ensure the catch, a watering was done after planting, and during the vegetation whenever it was needed. During the vegetation period, specific works were carried out, similar to 2017.

Observations and determinations carried out: Plant growth (plant height, number of flowers, number of fruits, average plant growth rate), Fruit characteristics (average weight of fruits), Fruit production (early production, total production, commercial quality of production), Determination of the content of bioactive compounds (polyphenols, flavonoids, monomeric anthocyanins):

- From the fresh eggplant shell samples were taken for, Anthocyanins, Total polyphenols content (TPC), Total flavonoids (TF), Antioxidant activity (FRAP) .

- From the fresh eggplant pulp samples were taken for: Total polyphenols (TPC), Total flavonoids (TF), Antioxidant activity (FRAP).

RESULTS OF PERSONAL RESEARCH

Experience I - The study of eggplant cultivation in different culture systems (2017)

Results regarding the influence of the culture and the culture system on the growth and fruiting of eggplant plants. The height of the eggplant plants cultivated in the conventional system were different from one cultivated to another. The size of the plants was higher in the varieties Zaraza, Japanese Pickling and JiloTingua Verde, where the difference from the average was very significant, from a statistical point of view. In the ecological system Talia plants had the maximum value of 71.93 cm in the JiloTingua Verde variety, where the difference registered compared to the average was 20.4 cm. Very statistically significant. Good growth was observed in Zaraza and Carina varieties, the difference from the average being distinctly significant and in the Black Beauty and Japanese Pickling varieties it was significant.

The flowering and fruiting of the plants was better in the cultivation carried out in the conventional system, where there was a greater number of buds, flowers and fruits / plant, compared to the ecological culture system. Compared to the average experience, flowering and fruiting was better in the varieties Zaraza, Japanese Pickling, Dourga and Monstrueuse de New York, especially in the culture carried out in the conventional system.

Results regarding the influence of the culture and the culture system on the eggplant production. By practicing the ecological culture system the eggplant production was on average in the 10 varieties, of 26.99 t / ha and in the conventional cultivation system, the production was 31.26 t / ha. Between the two cultivation systems there was a difference of 4.27 t / ha, the difference of production being significantly negative.

The average production achieved by the 10 varieties, cultivated in the field, in the two cultivation systems was 29.12 t / ha, with limits between 12 t / ha and 47.10 t / ha. In the conventional culture system the productions were higher in the varieties Zaraza with 32.55%, Violetta di Firenze, with 61.74%, Black Beauty with 46.97%, Monstrueuse de New York with 36.33% and Listada Da Gandia by 24.65%. In the ecological culture system the yields were higher in the varieties Zaraza with 11.60%,

Violetta di Firenze, with 42.85%, Black Beauty with 32.21%, Monstrueuse de New York with 11.26% and Listada Da Gandia with 14.01%, the production differences being statistically ensured. The Violetta di Firenze variety produced higher yields for both crop systems, with a production increase of 7.77%, for organic culture and 22.02% respectively for conventional culture.

Results regarding the influence of the culture on the content of bioactive compounds and on the antioxidant activity of the bark and the pulp of the eggplant. The anthocyanin content in the fresh skin was between 10.11 mg / 100g in Carina and 38.34 mg / 100g in Japanese Pickling. The total amount of polyphenols in the eggplant bark ranges from 182.88 mg GAE / 100g in Orange de Turquie and 356.68 mg GAE / 100g in Black Beauty. The total amount of flavonoids in the eggplant bark ranged from 0.00 mg quercitin / 100g in Orange de Turquie and 900.00 mg quercitin / 100g in Violetta di Firenze. The total polyphenol content in fresh cellulose ranged from 45.10 mg GAE / 100g in Orange de Turquie and 189.47 mg GAE / 100g in Carina. The total amount of flavonoid in the eggplant core ranged from 0.00 mg quercitin / 100g in Orange de Turquie and 468.72 mg quercitin / 100g in Carina cultivar. Antioxidant activity in eggplant kernels ranged from 8.81 mM FeSO₄ / g in Orange de Turquie and 23.22 mM FeSO₄ / g in Carina. The Vitamin C content of the Zaraza, Black Beauty and Japanese Pickling cultivars was analyzed and found to have a content of between 3.5 mg and 5.2 mg / 100 gpp. The total polyphenol content of steamed eggplant pulp was between 91.64 mg GAE / 100g at Black Beauty and 145.14 mg GAE / 100g at Monstrueuse de New York.

The total amount of flavonoids from steamed eggplant pulp ranged from 476.92 mg quercitin / 100g in Zaraza and 948.72 mg quercitin / 100g in Monstrueuse de New York cultivar. Antioxidant activity of the boiled product ranged from 50.13 mM FeSO₄ / g in Zaraza and 58.48 mM FeSO₄ / g in Monstrueuse de New York.

Experience II- The influence of cultivated and seedling of eggplant plants grown in different systems (average of 2018-2019).

Results regarding the influence of the culture, plant sowing and cultivation system on the growth and fruiting of eggplant plants. In the conventional cultivation system, the height of the plants was between 45.02 cm (Monstrueuse de New York variety, with sowing of 60.6 thousand plants/ha) and 61.87 cm (Japanese Pickling variety, sowing of 34.6 thousand plants/ha). In the ecological culture system, the height of the plants was between 41.31 cm (Monstrueuse de New York, the sowing of 45.5 thousand plants/ha and 54.88 cm (Violetta di Firenze, the sowing of 60.6 thousand plants/ha). The difference in height in the eggplant varieties cultivated in the two cultivation systems was between 1.45 cm and 10.45 cm. The largest differences in height were recorded in the Japanese Pickling 10.45 cm varieties, at the sowing of 34.6 thousand plants/ha followed by the Zaraza variety with 8.97 cm at the sowing of 34.6 thousand plants/ha.

In the conventional cultivation system, the number of fruits/plant was between 2.38 pieces and 5.88 pieces. In the organic cultivation system, the number of fruits per plant was between 1.75 pieces and 4.88 pieces. The difference between the average number of fruits/plant, in the eggplant varieties cultivated in the two cultivation systems was between 0.62 to 2.13 pieces, in favor of the conventional culture system.

Results regarding the influence of the culture, the planting and the crop system on eggplant production.

In the conventional culture system, the eggplant production was between 37.4 t/ha, in the Japanese Pickling variety and 63.8 t/ha in the Violetta di Firenze variety.

Compared with the average experience, of 51.4 t/ha, the production was higher by 12.61% to 24.09% in the varieties Monstrueuse de New York, Dourga and Violetta di Firenze. At the higher plantings up to 45.5 thousand plants/ha, respectively 60.6 thousand plants /ha, there were no significant differences in production, compared with the sowing of 34.6 thousand plants/ha. From the combined influence of the culture and the planting density to the eggplant culture carried out in the field in a conventional system, it was found that the production was different from one cultivar to another being slightly influenced by the number of plants at the surface unit. The largest productions were recorded in the varieties Violetta di Firenze, Dourga, Zaraza and Monstrueuse de New York. In the Violetta di Firenze variety, the maximum production of 76.4 t/ha was recorded at the sowing of 34.6 thousand plants/ha and as the plant sowing increased, the production decreased slightly.

In the Dourga and Monstrueuse de New York varieties, production increased as the planting distances were reduced, respectively the number of plants/ha increased.

In the ecological culture system, the eggplant production was between 27.9 t/ha, the Japanese Pickling variety and 54.6 t/ha the Violetta di Firenze variety. Compared to the average experience, of 44.4 t/ha, the production was higher by 10.36% to 22.97% in the Dourga, Monstrueuse de New York and Violetta di Firenze varieties. As the number of plants increased to the surface unit, by reducing the distance between plants from 50 cm to 40 cm, it was found that the production increased slightly up to 2.8 t/ha. If in the conventional crop system the highest production was registered at the maximum planting of 60.6 thousand plants/ha, in the ecological culture system the highest production was at the planting of 45.5 thousand plants/ha. The largest productions were recorded in the varieties Violetta di Firenze, Dourga, Zaraza and Monstrueuse de New York. In the Violetta di Firenze variety, the maximum production of 60.8 t/ha was recorded at the sowing of 34.6 thousand plants/ha and as the plant sowing increased, the production decreased slightly. In the Dourga and Monstrueuse de New York varieties the production increased as the planting distances were reduced, respectively the increase of the number of plants / ha, to the sowing of 45.5 thousand plants / ha. In the Zaraza variety, the production was higher at the sowing of 34.6 thousand plants/ha (51.5 t / ha).

Between the two cultivation systems, the varieties used recorded production differences between 3.5 t/ha and 9.5 t/ha. The smallest production differences found between the two cultivation systems used were in the varieties Listada Da Gandia, Zaraza and Black Beauty and the largest differences were found in the Japanese Pickling variety. Analyzing the combined influence of the variety and the system of culture on production it was found that the varieties Violetta di Firenze, Dourga and Monstrueuse de New York, produced above average production of experience in both culture systems. In conventional culture the production was higher than the average, the production differences being significant at all the decimals practiced in the experimental culture. In the case of the ecological crop, the productions were lower compared to the average of the variants, the lowest production being registered at the highest sowing of 60.6 thousand plants/ha, resulting in the fact that in the ecological crops a tenth of maximum 45 must be maintained, 5 thousand plants/ha.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions regarding the study of eggplant cultivation in different culture systems.

- The height of the eggplant plants cultivated in the field in the two cultivation systems, conventional and ecological, was on average 53.79 cm with limits between 24.01 cm and 73.72 cm. The size of the plants was higher at the Jilo Tingua Verde variety, 71.93 cm (in the ecological system) and 73.72 cm (in the conventional system). In the eggplant culture realized in the conventional system the average number of leaves on the plant was 21.85, registering a greater number (26.25-26.50) in the varieties Violetta di Firenze, Japanese Pickling and Dourga, the differences in comparison on average being very significant

- The flowering and fruiting of the plants was better at the cultivation carried out in the conventional system, where there was a greater number of buds, flowers and fruits / plant, compared to the ecological culture system. Compared to the average experience, flowering and fruiting was better in the varieties Zaraza, Japanese Pickling, Dourga and Monstrueuse de New York, especially in the culture carried out in the conventional system.

-In the conventional culture system the productions were higher in the varieties Zaraza with 32.55%, Violetta di Firenze, with 61.74%, Black Beauty with 46.97%, Monstrueuse de New York with 36.33% and Listada Da Gandia with 24.65%. In the ecological culture system the yields were higher in the varieties Zaraza with 11.60%, Violetta di Firenze, with 42.85%, Black Beauty with 32.21%, Monstrueuse de New York with 11.26% and Listada Da Gandia with 14.01%, the production differences being statistically ensured.

- The anthocyanin content in the fresh skin was between 10.11 mg/100g in Carina and 38.34 mg/100g in Japanese Pickling. The total amount of polyphenols in the eggplant bark ranges from 182.88 mg GAE/100g in Orange de Turquie and 356.68 mg GAE/100g in Black Beauty. The total amount of flavonoids in the eggplant bark ranged from 0.00 mg quercetin/100g in Orange de Turquie and 900.00 mg quercetin/100g in Violetta di Firenze. The antioxidant activity determined by the FRAP method ranged from 25.33 mM FeSO₄/g in the Orange de Turquie culture and 58.35 mM FeSO₄ / g in the Monstrueuse de New York.

- The total amount of flavonoids in the eggplant core ranged from 0.00 mg quercetin/100g in Orange de Turquie to 468.72 mg quercetin/100g in Carina cultivar. The total polyphenol content of steamed eggplant pulp ranged from 91.64 mg GAE/100g at Black Beauty to 145.14 mg GAE/100g at Monstrueuse de New York. The total amount of flavonoids from steamed eggplant pulp ranged from 476.92 mg quercetin/100g in Zaraza and 948.72 mg quercetin/100g in Monstrueuse de New York culture. Antioxidant activity of the boiled product ranged from 50.13 mM FeSO₄/g in Zaraza and 58.48 mM FeSO₄/g in Monstrueuse de New York.

Conclusions regarding the influence of the culture and the sowing of the eggplant plants grown in different systems

- The height of the plants was influenced by the cultivar used, by the number of plants/ha as well as by the cultivated system practiced. In the conventional cultivation system, the height of the plants was between 45.02 cm (Monstrueuse de New York variety, with sowing of 60.6 thousand plants/ha) and 61.87 cm (Japanese Pickling variety, sowing of 34.6 thousand plants/ha). In the ecological culture system, the height of the plants was between 41.31 cm (Monstrueuse de New York, the sowing

of 45.5 thousand plants/ha and 54.88 cm (Violetta di Firenze, the sowing of 60.6 thousand plants / ha).

-In the conventional cultivation system, the number of fruits/plant was between 2.38 pieces and 5.88 pieces. In the organic culture system, the number of fruits per plant was between 1.75 pieces, and 4.88 The difference between the average number of fruits/plant, in the varieties of eggplants grown in the two systems of culture was between 0.62 to 2.13 pieces, in favor of the conventional system of culture.

- In the conventional system of culture, The eggplant production was between 37.4 t/ha, in the Japanese Pickling variety and 63.8 t/ha in the Violetta di Firenze variety, from the combined influence of the cultivator and the planting size of the eggplant culture carried out in the field in its conventional system. found that the production was different from one culture to another being slightly influenced by the number of plants at the surface unit.

- In the conventional culture system, the largest productions were recorded in the varieties Violetta di Firenze, Dourga, Zaraza and Monstrueuse de New York. In the Violetta di Firenze variety, the maximum production of 76.4 t/ha was recorded at the sowing of 34.6 thousand plants/ha and as the plant sowing increased, the production decreased slightly. In the Dourga and Monstrueuse de New York varieties, production increased as the planting distances were reduced, respectively the number of plants/ha increased.

- In the ecological culture system, the eggplant production was between 27.9 t/ha, in the Japanese Pickling variety and 54.6 t/ha in the Violetta di Firenze variety. From the unilateral influence of the plant sowing on the production, in the eggplants grown in the field applying the ecological cultivation technology it resulted that the production ranged from 43.1 t/ha to the sowing of 60.6 thousand plants/ha and 46.5 t/ha , at the sowing of 45.5 thousand plants/ha.

-At the culture carried out in an ecological system, as the number of plants increased at the surface unit, by reducing the distance between plants in a row from 50 cm to 40 cm, there was a slight increase of the production up to 2.8 t/ha . Reducing the planting distance to 30 cm between plants/row caused the production to decrease compared to the variants planted to 40 cm between rows.

- In the ecological culture system, the largest productions were recorded in the varieties Violetta di Firenze, Dourga, Zaraza and Monstrueuse de New York. In the Violetta di Firenze variety, the maximum production of 60.8 t/ha was registered at the sowing of 34.6 thousand plants/ha and as the plant sowing increased, the production decreased slightly. In the Dourga and Monstrueuse de New York varieties the production increased as the planting distances were reduced, respectively the increase of the number of plants/ha, to the sowing of 45.5 thousand plants/ha.

- Between the two cultivation systems, the varieties used recorded production differences between 3.5 t/ha and 9.5 t/ha. The smallest production differences found between the two cultivation systems used were in the varieties Listada Da Gandia, Zaraza and Black Beauty.

Recommendations regarding the production of eggplant cultures in different systems

- Of the 10 experimental varieties, for the conventional culture system it is recommended to grow the varieties Violetta di Firenze (production increase 61.74%), Black Beauty (production increase 46.97%), Zaraza (production increase 32.55%), Monstrueuse de New York (36.33% production increase) or Listada Da Gandia (24.65% production increase).

- For the ecological cultivation system it is recommended to grow the varieties Violetta di Firenze (production increase 42.85%), Black Beauty (production increase 32.21%), Listada Da Gandia (production increase 14.01%), Zaraza (production increase 11.60%) or Monstrueuse de New York (production increase 11.26%).

-In conventional crops the planting density can be increased from 34.6 thousand plants/ha, up to 45.5 thousand plants/ha or even up to 60.6 thousand plants/ha, depending on the vegetative growth of the varieties used, ensuring - significant production differences.

-At the culture carried out in an ecological system, it is recommended to use smaller decimals because, as the number of plants increases at the surface unit, by reducing the distance between plants from 50 cm to 40 cm, it was found that the production was slightly increased up to 2.8 t/ha. Reducing the planting distance to 30 cm between plants/row caused the production to decrease compared to the varieties planted to 40 cm between rows.