

ABSTRACT

Tomato (*Solanum lycopersicum L.*) are probably the most popular agricultural species, and the fruits of this species are among the most consumed agri-food products in the world. Tomato are an important source of antioxidants in the human diet such as lycopene, polyphenols and vitamin C. The worldwide area cultivated with tomatoes in 2014 was over 4.8 million ha with a total production of over 160 million tons.

The ripe tomatoes are nutritionally balanced and can be grown in numerous production systems.

However, tomatoes are susceptible to many pests, often have no firmness and suffer impairment during manipulation. Tomato harvested at maturity in red benefit from the contribution of most of the components that contribute to the taste and aroma.

Fresh and processed tomatoes mainly provide the source of phyto-nutrients such as β -carotene and lycopene.

In addition to the genetic factors that can determine the special quality of tomato fruits, other technological factors that can contribute to its growth can be considered.

Although tomatoes are important sources for ensuring food security around the globe, the technological factors applied to the different production systems must be applied rationally to prevent, on the one hand, the ecological disaster, and on the other hand we must be aware of the quality of the product obtained.

Finally, the water resource must be regarded as a limited one, which is why this resource must also be viewed quantitatively, by saving but at the same time by making it more efficient to irrigate vegetable crops, in order to increase the quantity and quality of the vegetable production.

The researches carried out to elaborate the doctoral thesis with the title “*Contributions to the improvement of the quality of tomato fruits obtained in protected areas by some technological practices*” were carried out during 2016 - 2019, in the experimental field of Vegetable discipline at the Faculty of Horticulture from Iasi.

The main purpose of the doctoral thesis is to improve the quality of tomato fruits, obtained in protected areas, using varieties, fertilizers and differentiated irrigation measures.

To achieve this goal, the following major objectives have been set:

1. The influence of some technological factors (varieties, fertilization, irrigation) on the morphological characters (the height of the plant, the number of fruits, the mass, the diameter and the height of the fruits) in tomato as well as the combined influence of these factors on the morphological characters;
2. The influence of some technological factors (varieties, fertilization, irrigation) on fruit quality (mineral content, lycopene, polyphenols and antioxidant capacity), as well as the combined influence of these factors on the quality of tomato fruit;
3. The influence of some technological factors (varieties, fertilization, irrigation) on the production of tomatoes, as well as the combined influence of these factors on the production of tomatoes.

During the three years of study, the biological material used was represented by four tomatoes cultivars of Romanian and foreign origin, less widespread in the crop of protected areas, which may react differently under specific culture conditions, regarding the nutritional content in mineral elements, organic compounds, antioxidant capacity, the production obtained: Siriana F1, Minaret F1, HTP F1 and Inima de Bou.

For the fertilization proposed in the experimental protocol, the following fertilizers were used: Nutrispore[®], Orgevit[®], Micoseed[®], Dualgreen[®].

The observations were made for the three experiences, considering the evolution of phenomena and processes related to the development of tomato plants.

The obtained results were processed by statistical-mathematical methods, using the analysis of variation (ANOVA) for 95% confidence level, the Tukey and Duncan test to determine the significance of the differences.

The experiment was the basic method and consisted of establishing the experimental factors and their variants - they were studied both independently and in interaction.

The choice of experimental factors was made based on the thesis issues, respectively the need to improve the quality of the tomato fruits, obtained in spaces protected, by some technological practices.

At the same time, considering the requirements of tomato plants in relation to environmental conditions, temperature and humidity, we considered that all agrotechnical measures would meet these requirements, through the whole cultivation system.

The factors that will be studied during the experiment have been:

- Factor A - Cultivar had four graduations:

A1 – Siriana F₁

A2 - Minaret F₁

A3 - HTP F₁

A4 - Inimă de bou

- Factor B - The fertilization regime had four graduations:

B₁ - chemical fertilization using Nutrispore[®] with two formulas N: P: K, a complex fertilizer with N: P: K - 20:20:20, and 8:24:24, 400kg/ha, applied to the soil when preparing the loam;

- Nutrispore[®], N: P: K - 20:20:20 was applied to the preparation of the land in autumn, in the amount of 400 kg/ha.
- Nutrispore[®], N: P: K - 8: 24: 24, 200 kg/ha, applied in three rounds – during the vegetation period;

The first application for N: P: K - 8:24:24 was made 10 days after planting, when the seedlings were caught and started in vegetation; the second application was made when the first fruit of the first inflorescence had a diameter of about 1 cm; the third application was made when the first fruit reached maturity.

B₂ - organic fertilization with Orgevit[®], 1000kg/ha, applied to soil, at loam preparation, autumn;

- during the vegetation period fertilization with Dualgreen[®], N: P: K – 4: 8: 10, 300kg/ha, applied in three rounds, in the same phenophases as in chemical fertilization;

B₃ - fertilization with microorganisms, Microseed MB[®], 60 kg/ha, applied to the soil, when preparing the lot;

- in the period of vegetation Nutryaction[®], 5 l/ha, applied in three rounds;

B₄- control, unfertilized.

- Factor C - The irrigation regime had two graduations:

C₁ - 200 m³/ha, applied in 26 times (one watering rule/week), with a total of 5200 m³/ha;

C₂ - 300 m³/ha, applied in 26 times (one watering rule/week), with a total of 7800 m³/ha;

In order to achieve the purpose and the objectives that were drawn, an experience was organized in the subdivided parcels (split plot design), 12 plants/ each experimental repetition, 3 repetitions (the surface of a plot being 3.56 m²).

In total, the 32 experimental variants organized with three repetitions resulting in a total of 96 experimental plots, with a total area of 341 m².

The doctoral thesis comprises a number of seven chapters, divided into two parts:

Part I: The current state of knowledge regarding the improvement of the quality of tomato fruits through some technological practices. It comprises two chapters:

Chapter I: General considerations regarding tomato cultivation

Chapter II: Studies and researches on the quality of tomato fruits using different technological measures

Part II: Results of own research

Chapter III: Purpose and objectives of the research. Materials required and general working methodology

Chapter IV: The study of the natural and meteorological conditions in which the research was carried out

Chapter V: Results regarding the influence of some technological factors on the morphological characters of tomato

Chapter VI: Results regarding the influence of some technological factors on the quality of tomato fruits

Chapter VII: Results regarding the influence of some technological factors on tomato yield

Chapter VIII: General conclusions and recommendations

The bibliography is composed of 222 specialized titles, both from the country and abroad.

The first part of the document consists of two chapters and contains general information on the current state of research in the field of the doctoral thesis.

For the preparation of these chapters, documentation studies were carried out, using various sources: specialized treatises, journals, scientific articles, manuals, books, doctoral theses, as well as a series of recent web information.

The first chapter of the thesis is structured in four sub-chapters and deals with the importance of tomato culture, with reference to the food and therapeutic importance, the agrotechnical, social and economic importance, the description of the assortment of tomato used in the experience.

The second chapter consists of five sub-chapters, and contains general information from the specialized literature, regarding the current state of knowledge regarding the technological factors analyzed.

The second part of the thesis comprises a number of five chapters, with a weight of about 70% and consists of the author's own contribution on the research topic.

The third chapter includes the purpose and objectives of the doctoral thesis, the material and the general working methodology.

In **chapter four** the conditions of natural environment are presented; it is appreciated that there are favorable conditions of natural and technical-organizational framework for conducting the researchers within the doctoral thesis.

The fifth chapter contains the own results of the research regarding the influence of some technological factors on the morphological characters in tomatoes: the height of the plant, the number of fruits/plant, the average weight, the diameter, the height and the shape index of the fruits.

Results regarding the influence of the varieties of tomatoes on the morphological characters of tomato:

- the number of fruits, in the study of the influence of the cultivar, Siriana F₁, Minaret F₁, has obtained significant results;
- the height of tomato fruits at Siriana F₁, Minaret F₁ and Inima de bou, is influenced by the interaction fertilizer x irrigation regime. Siriana F₁, Minaret F₁ and HTP F₁ cultivars respond better to a low irrigation standard compared to Inima de bou;
- the shape index, within the study of the influence of the Siriana F₁, Minaret F₁, HTP F₁ and Inima de bou cultivars, has obtained significant results, hence their variation depending on the irrigation and fertilization regime;

Results regarding the influence of fertilization on the morphological characters of tomato:

- the highest number of fruits was obtained by the cultivator Siriana F₁ cultivar, irrespective of the fertilization regime at Ri₂;
- the highest number of fruits was obtained in case of fertilization with Nutrispore[®] for Ri₂ regardless of cultivar;
- the height of the fruits and the shape index varied according to cultivar and irrigation regime;
- the highest index of fruit shape was obtained in the variety Inimă de bou, regardless of the fertilization regime, at Ri₁;
- in case of cultivar interaction x irrigation regime, statistically assured values are obtained for p<0.05. The cultivar HTP F₁ irrespective of the fertilization regime, reacts best to the watering norm of 200 m³/ha as compared to the Inimă de bou, which obtains the best values for the same irrigation regime only in the case of the chemical and biological variant; Minaret F₁ cultivar, responds to the height of the plant best to the irrigation regime of 300 m³/ha, regardless of the type of fertilization.

Results regarding the influence of irrigation on the morphological characters of tomato:

- the highest values of the fruit mass regardless of cultivar for the norm of 5200 m³/ha are obtained in biologically fertilized versions;
- the diameter of the fruits, in the case of the influence of the irrigation regime, with 5200 m³/ha, varied according to cultivar and fertilization regime;
- fruit height and shape index varied according to cultivar and fertilization regime;

Results regarding the combined influence of the factors on some morphological characteristics of tomato:

- the height of the plant, the number of fruits, the diameter of the fruits and the shape index, varied according to cultivar, fertilization and irrigation regime;
- the height of the tomato fruit is a morphological index that in the case of the experience was significantly influenced by the cultivar, irrigation regime and fertilization regime.

The sixth chapter contains the results of the research regarding the influence of some technological factors on the content of mineral substances, lycopene, polyphenols and the antioxidant capacity of tomato fruits.

Regarding the influence of the technological factors on the quality of the tomato fruit, for the experimental period 2017-2019, about the mineral content, a higher percentage of macros and microelements from the chemically fertilized was observed compared to the control, irrespective of cultivar and the irrigation norm which denotes that the synthetically obtained mineral substances are more easily absorbed by the plants, under the conditions of protected spaces, where the temperature is also higher.

In organic and biologically fertilized variants the total polyphenol content is higher, compared to the chemically fertilized variant and in the control variant, which indicates that the synthetic fertilizers being more soluble are absorbed into the plant faster and the phenolic compounds do not have time to form, and by default to accumulate in fruit.

Obtained results highlight the favorable effect of organic fertilization and especially of biological fertilization on the antioxidant capacity of tomato fruit compounds, which creates a great advantage in promoting both practices, especially for organic farming, thus constituting an alternative to the system of conventional fertilization, fact determined by the superior quality of the obtained products.

The seventh chapter contains the own results of the research on the influence of some technological factors on the production of tomatoes.

For the experimental period 2017-2019, the production of tomato, in the study of the influence of the cultivars Siriana F₁ and Minaret F₁ obtained significant results, hence the variation according to the irrigation regime and fertilization. This varied depending on the cultivar and the irrigation regime in the case of the study of the influence of fertilization; the variant that obtained the highest production was HTP F₁ biologically fertilized.

In the case of the study of the influence of irrigation, tomato yield varied according to cultivar and fertilization regime. From the statistical point of view, insignificant results were obtained for $p < 0.05$, and within the study of the combined influence of the factors it registered the maximum value in the case of the cultivar HTP F₁ interaction x microbiological fertilization x the watering norm of 300 m³/ha.

The results confirm the achievement of the proposed purpose and objectives.