EVALUATING CULTIVARS FOR ORGANIC FARMING: TOMATOES, PEPPERS AND AUBERGINE IN SOUTH ROMANIA

E. Barcanu*, O. Agapie, I. Gherase, B. Tanase, G. Dobre

Vegetable Research Development Station Buzau, 23rd Mesteacanului Street, 120024, Buzau, Romania

Abstract

Organic farming has become a significant objective of the European Commission, and by 2030, EU member countries are required to find solutions to achieve the target of at least 25% of agricultural land being used for organic crops. As the area dedicated to organic farming continues to grow, there is a growing demand for cultivars that are optimized for this type of agricultural environment. Numerous studies have demonstrated that crop phenotypes can react differently when cultivated under different management systems, such as conventional versus organic. This has sparked a worldwide debate about whether we should develop cultivars exclusively for organic farming or if we can select suitable cultivars from conventional varieties for organic growing conditions. At the Vegetable Research Development Station Buzau, we have selected eleven cultivars of tomatoes (Siriana, Ema de Buzau, Flaviola, Ovidia, Hera, Andrada, Măriuca, Darsirius, Chihlimbar, Kristinica, Florina), five cultivars of peppers (Regal, Cantemir, A50, Roial, Decebal), and five cultivars of aubergine (Rebeca, Iarina, Romanița, H13Bz, H2Bz) that are typically suited for conventional farming. These cultivars were tested under organic farming conditions to investigate how genotypes interact in distinct growing systems and how this may impact yield and quality potential. Based on our study, we have drawn several conclusions. Darsirius has exhibited high ecological plasticity in both organic and conventional farming. Regal has shown uniform yields and fruits with high nutritional values in both growing systems. Rebeca has displayed tolerance to pest pathogens and has maintained stable yields under the studied systems. These findings are valuable for the ongoing efforts to develop cultivars that thrive in organic farming conditions and contribute to meeting the EU's organic farming goals. Additionally, they shed light on the adaptability of specific cultivars to different agricultural systems and offer insights into maximizing yield and quality potential under organic cultivation practices.

Keywords: *Capsicum annuum, conventional farming, ecological farming, Solanum lycopersicum, Solanum melongena*

1. INTRODUCTION

In the past century, agriculture has witnessed the overuse of chemical inputs, resulting in significant damage to our planet's soil, climate, water, and overall ecosystem. In response to these challenges, there is now a concerted effort to develop and adopt ecological farming practices to remediate the damage and prevent further harm. Organic farming has emerged as a vital objective of the European Commission, aiming to achieve at least 25% of agricultural land being dedicated to organic crops by 2030.

Organic farming is defined as a form of agriculture that relies on natural fertilizers and pesticides while strictly limiting the use of synthetic petrochemicals, genetically modified organisms, and other such methods (European Commission, 2014). At the European level, there is a strong commitment to transform agriculture into a sustainable sector that prioritizes welfare, quality, and minimizes environmental impact (Fortea et al., 2022). In Romania, organic farming is a dynamic and growing sector, actively encouraged through various agricultural policies (Manole et al., 2009).

According to Eurostat data for 2015, Romania ranks 17th globally in terms of arable land per capita (0.5 ha/habitant) and 9th in the EU concerning organic agricultural area. In 2015, organic farming covered 1.66% of the total agricultural area in Romania (Ministry of Agriculture and Rural Development Romania). Over the years, organic farming has experienced substantial growth, increasing by almost 67% between 2012 and 2022, thanks to the implementation of structures supporting organic product production (Stoica et al., 2022).

With the expansion of organic farming areas, the demand for cultivars optimized for this specific environment has intensified. Organic farmers advocate for the development of specific hybrids or cultivars suited for nonchemical farming systems, as studies have shown distinct expression of crop phenotypes when grown under different management systems, such as organic versus conventional (Lammerts van Bueren et al., 2010; Mason and Spaner, 2006; Loschenberger et al., 2008; Reid et al., 2011; Wortman et al., 2013; Barcanu et al., 2020).

The debate continues on whether we should breed cultivars exclusively for organic farming or select suitable varieties from conventional breeding for organic growing conditions. To assess the adaptation of conventionally developed hybrids and cultivars to organic systems, a rapid method involves evaluating genotype by system interaction by testing existing cultivars in both systems (Wortman et al., 2013). In light of these considerations, at Vegetable Research Development Station Buzau, we have selected specific cultivars of tomatoes (*Solanum lycopersicum* L.), peppers (*Capsicum* spp.), and aubergines (*Solanum melongena* L.) suited for conventional farming to be rigorously tested under organic farming conditions. The goal is to understand how these cultivars interact within distinct growing systems and evaluate their yield potential and quality attributes, further advancing the development of sustainable and ecologically-friendly agricultural practices.

2. MATERIALS AND METHODS

2.1. Experimental site

The experimental research site was situated at 45°08'60.00"N and 26°49'59.99"E (Figure 1), with an average annual precipitation of 530 mm, approximately 60% of which occurred as rain during the Solanaceae family's growing season in temperate climate.

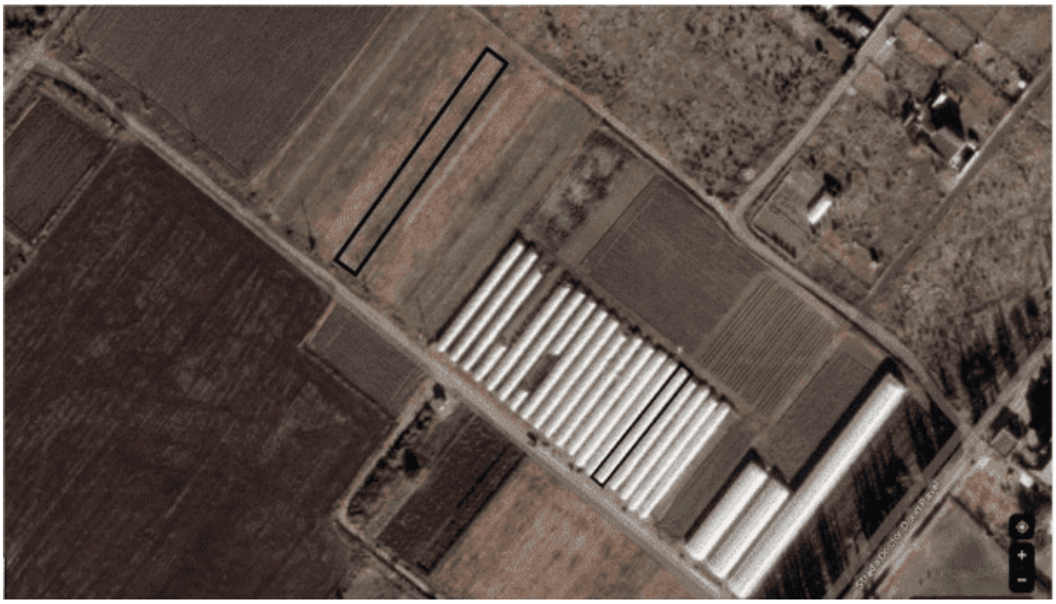

Fig. 1. Satellite view of the experimental field.

The weather data were closely monitored and recorded between May and October 2022, while the crops were cultivated on sandy loam soil with a pH value of 7.0. The soil had a medium humus content at 3.15%, and the organic matter content was good at 8.5%. The weather conditions during the experiment were compared to multiannual weather conditions (Figure 2), providing valuable insights for the research.

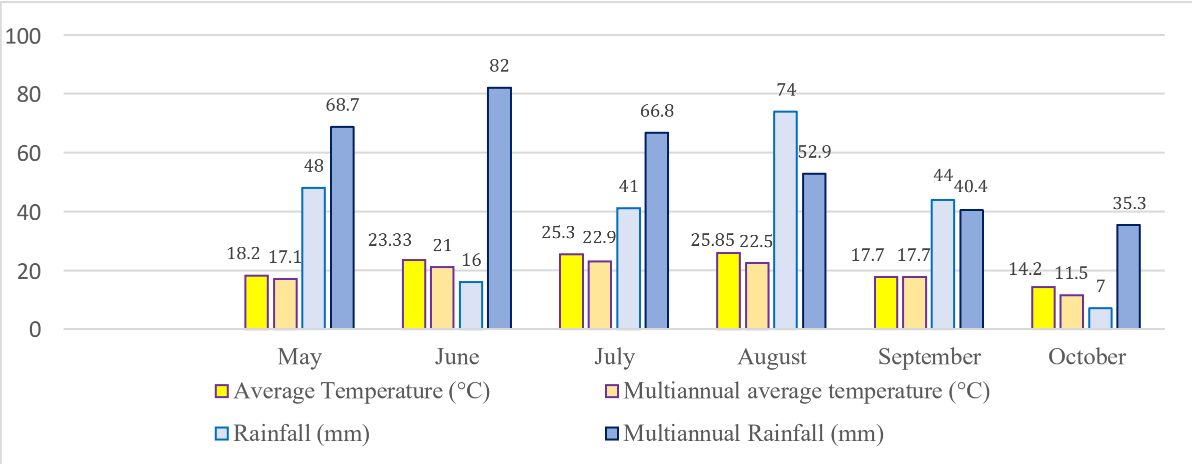

Fig. 2. Climatic conditions from May to October 2022

2.2. Genotype Resources

The studied genotypes were selected from the Vegetable Research and Development Station (VRDS) in Buzău, Romania. The focus of the study was on eleven tomato genotypes (*Solanum lycopersicum* L.), comprising five indeterminate varieties (Siriana, Ema de Buzau, Flaviola, Hera, Andrada), five determinate varieties (Măriuca, Darsirius, Chihlimbar, Kristinica, Florina), and one semi-determinate cultivar (Ovidia) (Figure 3).

Fig. 3.Tomato fruit cultivars: a). Andrada, b). Hera, c). Siriana, d). Ovidia, e). Flaviola,f). Ema de Buzău g). Darsirius, h). Chihlimbar, i). Kristinica, j). Florina, k). Măriuca.

Additionally, five cultivars of *Capsicum* spp. (Figure 4) were included, consisting of three sweet pepper genotypes (Regal, Cantemir, A50) and two hot pepper genotypes (Roial and Decebal).

Fig. 4. Pepper fruit cultivars: a). Cantemir, b). Regal, c). Roial, d). Decebal, e). A50

For eggplants (*Solanum melongena* L.), five genotypes (Rebeca, Iarina, Romanița, H13Bz, and H2Bz) were chosen for cultivation in organic and conventional system (Figure 5).

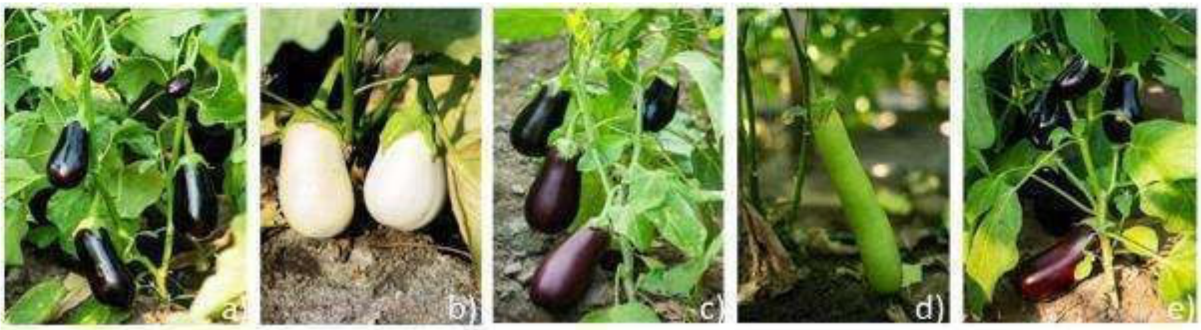

Fig. 5. Eggplant fruit cultivars: a) Rebeca, b) Romanița, c) H2BZ, d) Iarina, e) H13Bz

The seed of each genotype were sown in alveolar pallets with 70 cubes and a volume of 50 cm^3, utilizing peat as the substrate. The seedlings were nurtured in a greenhouse where vegetation factors could be controlled for optimal seedling development. Transplanting of seedlings to the open field was carried out in the first decade of May 2022. To promote rapid root growth and nutrient assimilation, a 4% N and 10.7% free amino acids solution was administered at a dose of 300ml/1000 m^2 during the first irrigation after transplanting.

The plants were arranged in a randomized complete block design using inter and intra-row spacing of 70 cm and 30-35 cm, respectively. To ensure sufficient water supply for the crops, drip irrigation was utilized as the most efficient water and nutrient delivery system. For pepper and indeterminate tomato plants, an innovative fence system using *Helianthus tuberosus* shoots was employed (Figure 6). Additionally, windbreaks were established using corn (*Zea mays*), Jerusalem artichoke, and climbing bean plants (*Phaseolus* sp.).

The conventional crop management followed traditional chemical fertilization practices, employing solid chemical fertilizers tailored to meet the nutrient requirements of peppers. The fertilization schedule involved three applications of NPK 20-20-20 just before planting, followed by NP 15-50 + 2MgO at the beginning of the floral bud phase, and finally, NPK 9-18-27+ 2MgO during the fruit setting period.

The organic fertilization program consisted of four applications with (NOV@) containing: 21% organic carbon, 5% K_2O, and 0.6% betaine at a dose of 25 kg/1000 m^2. Additionally, four foliar fertilizations were done with (Fylloton) containing: 6% N, 11% organic carbon, 37.5% essential amino acids, and 35% organic matter from *Ascophyllum nodosum*.

For pest prevention, we used microorganisms such as *Metarhizium anisopliae* (CFU/ml 1x 10^8 gm min) at a foliar application dosage of 15 ml/L water, and *Verticillium lecanni* (CFU/ml 7x 10^8) with a dosage of 5 ml/L water. To control disease, we applied three foliar treatments with 10.5g/10 L of *Bacillus subtilis* and *Trichoderma harzianum* (CFU 2 x 10^8/ml min.), as well as two seedling treatments with *Trichoderma viride* (CFU 2x 10^9/per gm) at a dosage of 10 g/L water. Solanaceous fruits are among the favorite menu items for certain insects; hence, we used companion plants such as *Ocimum basilicum, Tagetes patula, Tropaeolum majus, Thymus vulgaris, Calendula officinalis, Limonium sinuatum, Zinnia elegans*, and *Cosmos bipinnatus* to maintain a healthy crop (Figure 6).

Fig. 6. a). Fence system using *Helianthus tuberosus* shots b). Climbing bean windbreaksc). Companion plants: Hot peppers and basil.

2.2.2 Fruit Material

The quality assessment of tomato and pepper genotypes cultivated in both organic and conventional conditions in the open field involved the evaluation of several parameters, including firmness (N), total soluble solids (TSS %), titratable acidity (TA) expressed in citric acid, TSS/TA ratio, dry matter (DM), carotene, and lycopene content. For eggplants, quality evaluation focused on firmness and dry matter content. Tomatoes and eggplants were assessed for quality at the harvesting maturity stage, while for peppers, fruit quality was determined at both green and red maturity stages. Five fruits were randomly selected from each genotype and analyzed. For dry matter, total soluble content, acidity, lycopene, and β-carotene analysis, randomly mixed samples were prepared for each genotype and analyzed intriplicate. All determinations were carried out on the day of harvest.

2.2.3 The Analytical Methodology Used

2.2.3.1. Determination of Dry Matter Content (TDM, %)

The dry matter content of the fresh sample was determined following the guidelines of AOAC 930.04, "Loss on Drying (Moisture) in Plants" (2005).

2.2.3.2. Determination of Total Soluble Solids (TSS, °Brix,)

To estimate the total soluble solids (TSS) in the homogenized juice obtained from pressing the fresh fruit, a portable digital refractometer (KERN OPTICS ORF 1RS) was used. The results were expressed in °Brix, and the analysis was performed according to AOAC 932.12 methods.

2.2.3.3 Titratable Acidity Analysis

Total titratable acidity was determined by taking 5 g of ground fruit and diluting it in 25 mL of double-distilled water. The titratable acidity of the sample was determined by titration with 0.1 N NaOH until the pH reached 8.1. The titration was carried out using TitroLine easy (Official method AOAC 942.15), and the results were expressed as g citric acid per 100 g of pulp.

2.2.3.4 Determination of β–Carotene and Lycopene

The quantification of lycopene and β-carotene was conducted following the method developed by Nagata and Yamashita (1992) with slight modifications. One gram of tomato or pepper sample was homogenized with 10 ml of hexane: acetone (4:6 v/v). Absorbance readings were taken at specific wavelengths (663 nm, 645 nm, 505 nm, and 453 nm), and the pigment content was calculated using the provided equations:

β-carotene mg $(mL)^{-1}$ = 0.216A663 - 1.220A645 - 0.304A505 + 0.452A453 Lycopene mg $(mL)^{-1}$ = - 0.0458 A663 + 0.204A645 + 0.372 A505 – 0.0806 A453

The results were expressed mg $\cdot mL^{-1}$.

2.2.3.5 Fruit firmness

The fruit firmness was measured using an electronic penetrometer TR Turoni 53205 equipped with a 3 mm pistol, and the results were expressed in Newtons (N).

2.2.3.7 Statistical Analysis

Statistical analyses were performed using analysis of variance (ANOVA). In the case of a significant F-value, the means were compared using the Duncan test.

3. RESULTS

3.1. Solanaceous fruit yields in two systems

Figure 7 displays the tomato yields of 11 cultivars grown in both organic and conventional farming systems. The yields were measured in kg/plant, with the highest recorded by the Siriana cultivar in both systems, reaching 4.75 kg/plant in conventional and 4.28 kg/plant in organic farming. On the other hand, the Ovidia cultivar exhibited the lowest yield in the organic system, producing only 2.16 kg/plant, while the Kristinica genotype achieved 2.70 kg/plant in the conventional farming setup. The differences in yields among the genotypes were not statistically significant in the studied systems, with the Darsirius genotype demonstrating very similar yields in both systems, yielding 2.91 kg in organic and 3.17 kg in conventional farming.

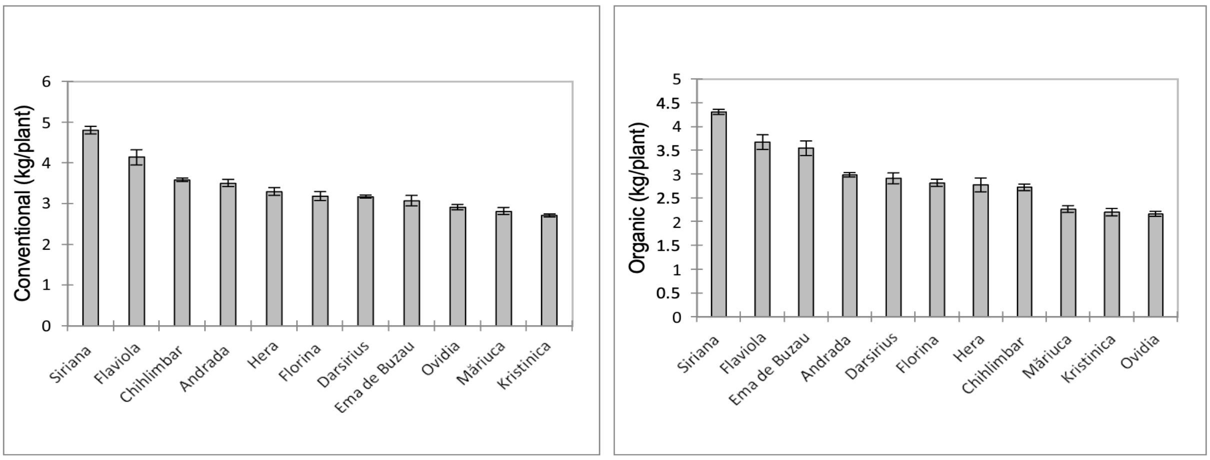

Fig. 7. Tomato yield in both farming systems

Figure 8 illustrates the pepper yield of our five genotypes, each demonstrating distinct behavior. In the conventional system, A-50 showcased the highest yield, while in organic farming, Regal attained the peak result. Conversely, the lowest yields in the organic system were recorded by our hot pepper cultivars, Roial and Decebal. We denoted all the genotypes grown in the organic system with 'O', and the genotypes grown in the conventional system with 'C'.

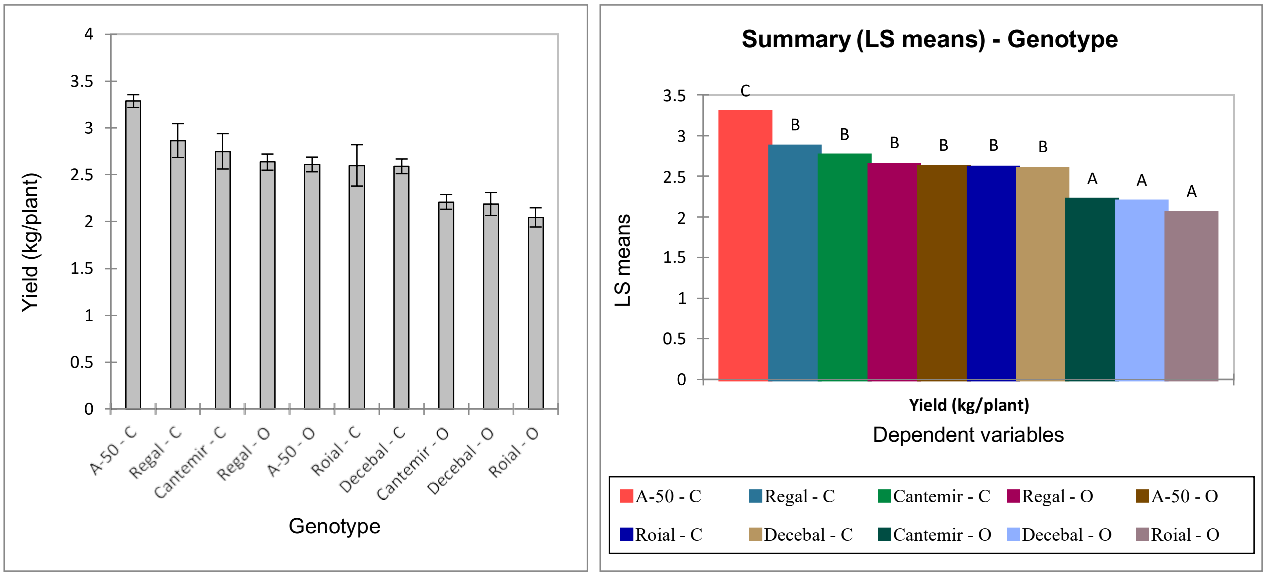

Fig. 8. Comparative pepper yields in conventional and organic farming systems

Based on our yield results for aubergine genotypes (Figure 9), it is evident that the Rebeca genotype performed exceptionally well in both conventional and organic farming systems, delivering the highest yields. On the other hand, our specialties cultivars, Iarina (slim-green cultivar) and Romanița (white skin cultivar), recorded the lowest yields. All genotypes grown in organic system were denoted with 'O', while genotypes grown in conventional system were denoted with 'C'.

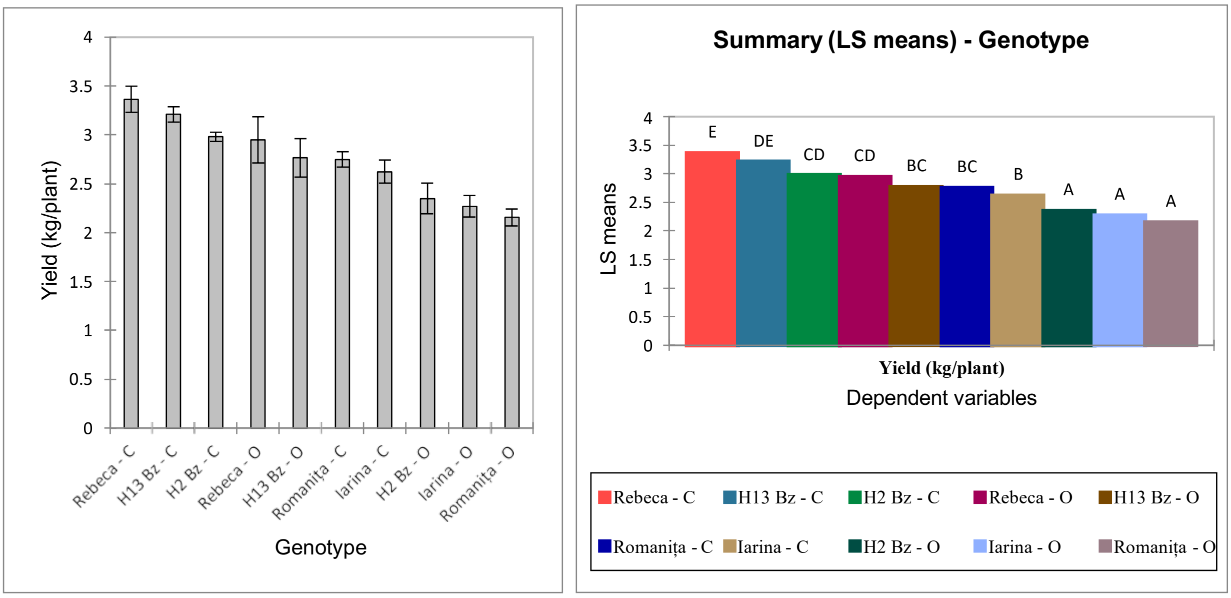

Fig. 9. Comparative eggplant yields in conventional and organic farming systems

3.1 Tomato/ Physicochemical properties of tomatoes

Table 1 summarizes the mean values for the nutritional analysis of organic (O) and conventional (C) tomatoes, including dry matter (TDM), β-carotene, and lycopene. Additionally, the table presents the mean values for genotype quality analyses, such as firmness (N), TSS (°Brix), TA (citric acid%), and fruit weight (FW, g).

Cultivar	Firmness (N)	TSS (°Brix)	TDM %	TA (%)	FW (g)	Lycopene (mg /mL)	β-carotene (mg/mL)
Ema de Buzau O	**1.17** ^{a}	6.14 ^{b}	**10.82** ^{b}	0.60 ^{c}	**8.88** ^{a}	8.3 ^{d}	9.3 ^{b}
Ema de Buzau C	**1.21**	6.08	10.03	0.67	9.25	6.2	8.8
Chihlimbar O	5.43 ^{cde}	5.43 ^{ab}	6.92 ^{ab}	**0.87** ^{d}	190.21 ^{f}	-0.013 ^{ab}	**16.1** ^{c}
Chihlimbar C	5.55	5.11	6.97	0.91	210.33	-0.009	**15.2**
Andrada O	4.43 ^{bcde}	5.03 ^{ab}	6.35 ^{a}	0.44 ^{ab}	247.56 ^{g}	**12.7** ^{e}	3.7 ^{ab}
Andrada C	4.56	4.87	6.46	0.48	**289.9** ^{g}	9.21	3.6
Hera O	2.97 ^{b}	5.38 ^{ab}	7.48 ^{b}	0.45 ^{ab}	152.34 ^{def}	5.5 ^{cd}	3.8 ^{ab}
Hera C	3.15	5.15	7.59	0.51	168.75	4.1	3.4
Florina O	**7.18** ^{f}	**4.38** ^{a}	**4.74** ^{a}	0.49 ^{abc}	170.68 ^{ef}	7.3 ^{cd}	4.7 ^{ab}
Florina C	7.17	4.41	4.88	0.53	199.39	5.2	4.5
Mariuca O	5.75 ^{ef}	4.68 ^{a}	7.65 ^{b}	0.43 ^{ab}	84.13 ^{bc}	5.5 ^{cd}	3.8 ^{ab}
Mariuca C	5.83	4.72	7.72	0.49	98.75	4.3	3.1
Darsirius O	5.60 ^{def}	4.81 ^{a}	6.64 ^{ab}	**0.38** ^{a}	109.27 ^{cd}	7.5 ^{d}	3.3 ^{ab}
Darsirius C	5.67	4.85	6.79	0.41	120.91	6.9	2.9
Kristinica O	3.70 ^{bc}	4.54 ^{a}	6.70 ^{ab}	0.44 ^{ab}	128.43 ^{de}	5.7 ^{cd}	4.7 ^{ab}
Kristinica C	3.76	4.63	6.85	0.51	138.44	5.2	4.1
Siriana O	3.92 ^{bcd}	4.43 ^{a}	4.95 ^{a}	0.46 ^{ab}	130.56 ^{de}	3.5 ^{bc}	3.2 ^{ab}
Siriana C	3.99	4.39	4.99	0.52	157.87	2.9	2.9
Ovidia O	1.30 ^{a}	4.50 ^{a}	7.25 ^{b}	0.58 ^{bc}	55.17 ^{b}	**-0.001** ^{a}	1.7 ^{a}
Ovidia C	1.46	4.11	7.32	0.65	88.52	**-0.001**	**1.2**
Flaviola O	2.78 ^{b}	**7.98** ^{b}	6.68	0.68 ^{c}	26.71	4.0 ^{bc}	5.01 ^{ab}
Flaviola C	2.77	6.22	6.79	0.65	31.33	3.23	4.5
Pr > F(Model)	<0.0001	0.259	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Significant	Yes	No	Yes	Yes	Yes	Yes	Yes
Pr > F(Cultivar)	<0.0001	0.259	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Significant	Yes	No	Yes	Yes	Yes	Yes	Yes

Table 1. Comparative physicochemical properties of tomatoes in conventional and organic farming.

The results obtained highlight that tomato cultivars significantly differed ($p<0.001$) in firmness of their fruits. The highest value, of 7.18 N was obtained by Florina O cultivar, while the lowest value, of 1.18 N was registered by Ema de Buzău C genotype. Also, in terms of chemical indicators such as total dry matter (%), total acidity (citric acid %) and ratio TSS/TA, significantly statistical differences was obtained.

Regarding the influence of the cultivar on the dry matter content of tomato fruits, it varied from 4.74%, (Florina O) to 10.82% (Ema de Buzău O). A low content in dry matter was registered in the Siriana cultivars (4.43% in organic farming and 4.95% in conventional farming).

Ilić et al., (2014), indicates that the organic acids in tomato fruit consist of mainly citric and malic acid with a range of 0.3 to 0.6%, but in our research titratable acidity express as citric acid in tomato genotypes showed an oscillating amplitude between 0.38% (Darsirius O) to 0.87% g/l (Chihlimbar O).

In order to have a reasonable quality, fresh tomatoes cultivar should contain a TSS/TA ratio value higher than 16 and soluble solids higher than 4° Brix (Araujo et al., 2014). From Table 3 it can be easy to observe that our results referring to TSS content are in agreement with Araujo et al., 2014.

Analyzing the average content of each parameter by statistical comparisons according to genotype, it is observed that the content in TSS do not show statistical differences. The highest sugar content, of 7.8° Brix and 6,14° Brix, was recorded for cherry type tomatoes, respectively Flaviola and Ema de Buzău inboth growing systems.

After analysing the levels of lycopene and β-carotene in organic tomatoes, we observed statistically significant differences between cultivars. The Andrada cultivar exhibited the highest lycopene content (12.7 mg/mL in the organic system), while the Chihlimbar cultivar had the highest β-carotene content (16.1 mg/mL in the organic system, followed by 15.1 mg/mL in conventional farming). On the other hand, the Ovidia cultivar recorded the lowest values, with β-carotene at 1.2 mg/mL in conventional farming and 1.7 mg/mL in the organic system. Furthermore, lycopene was not detected in either the Ovidia or Chihlimbar genotypes. These results suggest that the genotypes may carry mutations in genes related to carotenoid or isoprenoid biosynthesis, such as *yellow flesh (r)* (Fray and Grierson, 1993; Yoo et al., 2017) or *apricot (at)* (Pankratov et al., 2016; Yoo et al., 2017), leading to the absence of lycopenein ripe tomato fruits.

A highly significant difference ($p<0.0001$) was observed in fruit weight among the studied cultivars. The ox-heart variety, Andrada C, exhibited the maximum fruit weight of 247.56 g, whereas the cherry type cultivar, Ema de Buzău O, displayed the lowest fruit weight of 8.88 g.

3.2 Pepper/ Physicochemical properties of peppers

Table 2 presents the physicochemical properties of peppers harvested at two maturity stages: green, denoted 'I' with the table and red denoted with 'M' in the table. The use of 'O' denotes the organic growing cultivars, while 'C' represents the conventional system genotypes. Consumer preference is often driven by pepper quality attributes such as fruit firmness and crispness. In our study, the firmness of green fruits varied from 9.76 N (Cantemir, grown in conventional system) to 6.13 N (Roial, grown in organic system). For red fruits, Cantemir cultivar also exhibited the highest value (10.56 N), while Regal had 6.13 N, in organic farming.

Cultivar	Firmness (N)	TSS (°Brix)	TDM%	TA (%)	FW (g)	Lycopene (mg/mL)	β-carotene (mg/mL)
Roial M - O	6.88 abc	**8.36** e	**14.61** i	0.28 a	**21.99 a**	0.29 f	5.0 c
Roial M - C	7.01	9.02	14.22	0.31	23.72	0.21	4.3
Regal M - O	8.89 bcd	5.93cd	4.13 a	0.29 a	138.16 c	0.27 f	6.2 c
Regal M - C	8.97	5.81	4.26	0.30	141.03	0.22	5.5
Decebal M – O	7.91 abcd	8.15 e	11.68 h	0.27 a	32.13 a	-0.04 b	4.5 bc
Decebal M - C	7.99	7.97	11.99	0.28	37.93	-0.02	3.9
A-50 M - O	8.05 abcd	6.00 cd	9.65 g	0.21 a	**168.60 d**	**0.90 e**	**9.8 d**
A-50 M - C	8.22	5.93	9.76	0.22	170.81	0.72	8.8
Cantemir M – O	10.00 d	3.84 ab	7.81 f	0.26 a	118.4 c	0.22 ef	4.7 c
Cantemir M - C	**10.56**	3.72	7.93	0.28	121.3	0.18	4.1
Cantemir I – O	9.25 cd	2.84 a	6.67 d	0.40 a	107.53 b	0.02 d	**0.1 a**
Cantemir I – C	9.76	**2.71**	6.89	**0.41**	106.33	0.02	**0.1**
Roial I – O	5.78 a	6.87 d	9.21 g	0.13 a	17.07 a	**-0.004 c**	**0.1 a**
Roial I – C	5.83	6.65	9.41	0.14	17.99	-0.003	**0.1**
A-50 I – O	8.98 bcd	4.75 bc	7.28 e	0.11 a	137.47 c	-0.274 a	1.9 ab
A-50 I – C	9.07	4.45	7.36	0.10	143.89	-0.271	1.5
Decebal I – O	7.51 abcd	3.49 ab	**5.29 b**	**0.09 a**	27.40 a	-0.004 c	0.4 a
Decebal I – C	7.77	3.22	5.46	0.11	30.87	-0.003	0.4
Regal I – O	**6.13 ab**	3.84 ab	5.44 c	0.18 a	90.57 b	0.002 d	0.3 a
Regal I – C	6.24	3.75	5.78	0.21	93.6	0.002	0.2
Pr > F(Model)	0.046	<0.0001	<0.0001	0.591	<0.0001	<0.0001	<0.0001
Significant	Yes	Yes	Yes	No	Yes	Yes	Yes
Pr > F(Varietatea)	0.046	<0.0001	<0.0001	0.591	<0.0001	<0.0001	<0.0001
Significant	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 2. Comparative physicochemical properties of peppers in conventional and organic farming.

The dry matter in peppers serves as an indicator of harvest time, yield quality, and quantity. In our study, Roial M-C cultivar exhibited the highest dry matter (14.61%), while Decebal I-C cultivar showed the lowest on green fruit (5.29%). Titratable acidity influences the perception of pepper fruit sourness. In our study, Decebal in green stage fruit had the lowest acidity (0.09%), while Cantemir variety had the highest (0.41%). Fruit weight also varied significantly between cultivars, with Roial having the highest (21.99 g) and Cantemir the lowest (168.6 g).

Bell peppers are rich in carotenes like lycopene and beta-carotene, which can vary in composition and content due to different genotypes, cultivation, and ripeness (Conforti et al., 2007; Hallmann and Rembialkowska, 2012). Lycopene was not detected in green fruits and orange cultivar (Decebal) in our study, while its content in red fruits ranged from 0.9 mg/mL in A-50 to 0.29 mg/mL in Roial cultivar. Beta-carotene content was higher in red fruits, varying from 3.9 mg/mL in Decebal genotype to 9.8 mg/mL in A-50 genotype.

3.3 Aubergine/ Physicochemical properties of eggplants

Eggplants are cultivated primarily for their fruits, which, although they may have a lower nutritional value compared to other vegetables, are highly esteemed in the culinary world due to their delightful taste and versatility in various dishes, whether prepared fresh or canned. Eggplant fruits are consumed at technical maturity.

In assessing the quality of eggplant fruits, two key determinations were made: firmness and dry matter. Notably, the Rebeca, H13Bz, and H2Bz genotypes exhibited the highest firmness values, indicating superior storage capabilities in comparison to the Iarina and Romanita varieties. Dry matter content also showed significant variation among the cultivars, ranging from 5.31% in the Romanita variety to 10.28% in Rebeca, reflecting differences in fruit composition and density.

4. DISCUSSIONS

In the climatic year 2022, the extreme maximum and minimum temperature had not exceeded the recorded multiannual temperature. Instead, the mean temperature of the 2022 had surpassed every month from January to October. The beginning of the year 2022 has started with a precipitation deficit, which persevered almost the entire vegetation period. According to Brezeanu et al., (2020) significant climatechanges registered over the past few years in Romania have demonstrated the vital importance to preserve our natural resources to ensure a steady food supply to people. Furthermore, vegetables qualityis a function of several factors including the choice of cultivar, cultural practices, harvest time and method, handling procedures and storage. Increased interest in organic vegetables production imposed the need to evaluate the quality and nutritional value of vegetable grown in organic system (Ilić et al., 2014), reason why, in this study we evaluated tomato, peppers and eggplants cultivars for organic farming.

Based on the fruit yield results, our conclusions indicate that the performance of tomato cultivars tested in conventional farming is relatively similar in organic systems. This observation is drawn from the lack of a significant genotype by system interaction during this year of study. As our testing was limited to one year, we plan to conduct further experiments in subsequent years to validate our hypothesis.

When aiming for maximum crop yields, we recommend selecting the highest-yielding genotypes among the studied pepper cultivars based on university uniform test comparison trials in both conventional and organic systems. Our results indicate significant differences between the two systems, with the highest yield recorded in conventional farming. However, it is essential to consider that certain crop qualities, such as antioxidant content, lycopene, and beta-carotene levels, might be more influenced by genotype by system interactions. Further studies, conducted over multiple consecutive years, will allow us to assess the adaptability of the selected cultivars to the unique challenges of organic crop production, including weed pressures and other distinctive characteristics. As of now, we cannot adequately determine their suitability for organic farming until these cultivars undergo testing for more than one year in organic systems.

About eggplants results, fortunately, they thrive in both conventional and organic farming practices, demonstrating remarkable resistance and tolerance against various types of biotic stress, which are common challenges in the Solanaceae family. This adaptability makes them a reliable crop with high yields in both farming systems.

Firmness is a critical variable that indicates the texture and consistency of the fruit. This attribute plays a crucial role in determining the optimal harvest time, quality evaluation during storage, marketing in the fresh state, or for processing (Flores-Velasquez et al., 2022). In our study, the results revealed that processing tomatoes (Măriuca, Florina, Darsirius, Kristinica, and Chihlimbar) exhibited higher firmness levels than the fresh market types (Siriana, Andrada, Hera, Ovidia, Ema de Buzău, Flaviola). These findings align with the research of Tigist et al. (2011) and Lana et al. (2005). As for the firmness of the studied peppers, Palacio and Sánchez (2017) reported lower bell pepper firmness values (between 6.39 and 7.0 N), while Figueroa et al. (2015) reported significantly higher values (12.64 N and 21.60 N). In our study, purple aubergine cultivars (Rebeca, H13Bz, and H2Bz) demonstrated superior firmness when compared to the green (Iarina) and white (Romanița) varieties. However, it is important to note that the latter two genotypes possess several appealing characteristics for consumers, such as their delicate taste, visual attractiveness, and tender texture, making them highly desirable options for culinary applications.

Organic acids and sugars comprise the majority of the total dry matter content of tomato fruit (Malundo et al., 1995). Ripe tomato fruit contains an average of 3.0–8.88% dry matter, consisting of 25% fructose, 22% glucose, 1% sucrose, 4% malic acid, 9% citric acid, 8% protein, 8% mineral elements, 7% pectin, 2% lipids, 6% cellulose, 4% hemicellulose, and the remaining 4% are amino acids, phenolic compounds, vitamins, and pigment (Kurina et al., 2021). The composition of these compounds varies depending on genotype, growing conditions, and fruit development stage (Alsina et al., 2021) as also seen in our research.

In our study, the Ema de Buzău cultivar exhibited a TDM (total dry matter) content exceeding 10%, a value that surpasses the mentioned interval. According to Beckles (2012), dry matter content is inversely proportional to fruit size. Interestingly, our findings showed that the smallest cherry-type cultivar, Ema de Buzau, recorded the highest dry matter value. Conversely, the Florina cultivar, with the lowest dry matter value, had the lowest TSS (total soluble solids) content.

In the literature, there are data published by authors such as Murariu et al. (2021), who found values for dry matter content of tomatoes ranging from 7.66% to 11.64%.

Moreover, the high content of dry matter is an important quality descriptor in the food industry for obtaining chili powder (Ribes-Moya et al., 2018). Previous research (Brezeanu et al., 2022) on sweet pepper genotypes grown in organic systems reported total dry matter values ranging from 4.83% to 17.78%.

Sugars in tomatoes primarily consist of reducing sugars, fructose, and glucose, with trace amounts of sucrose. The content of reducing sugars in tomatoes generally correlates with the total soluble solids (TSS) content, which serves as an indicator of sweetness and is one of the most important quality factors for tomatoes (Malundo et al., 1995). The soluble solids in tomatoes encompass organic acids, minerals, lipids, pigments, and a small quantity of sucrose. In our study, the TSS content of tomato cultivars ranged between 4.38° Brix and 6.98° Brix. These results align with findings provided by Murariu et al.,2021, for organic tomatoes from Romania.

Regarding the TSS content of the studied peppers, it varied between 2.71° Brix and 8.36° Brix. Previous studies in Romania reported sugar content ranging from 3.5° Brix to 7° Brix (Soare et al., 2017) and from 4.89° Brix to 6.86° Brix (Brezeanu et al., 2022).

Lycopene, a carotenoid pigment found in red fruits and vegetables, is considered a potent antioxidant (Agarwal and Rao, 2000). Preliminary research suggests that individuals who include tomatoes in their diet may potentially have a reduced risk of cancer, possibly due to lycopene's impact on prostate cancer mechanisms. However, it is essential to note that the available data on this subject are still insufficient for conclusive findings (Vance et al., 2013; Khan et al., 2008). As expected, the concentration of lycopene in yellow and orange tomatoes, such as Ovidia and Chihlimbar, was below the limits of detection. The same result was obtained for the Decebal variety, which had orange fruit.

β-carotene is a precursor of vitamin A and is associated with chloroplasts, functioning as an antioxidant and energy transporter, reducing when their proliferation is limited (Farneti et al., 2012). Murariu et al., 2021, reported β-carotene content in organic tomatoes ranging from 3.60 mg·100 g-1 F.W to 9.27 mg·100 g-1 F.W. Notably, the β-carotene significantly increased compared to the values from the current research (0.03–0.98 mg·100 mL-1). The literature presents values of β-carotene for different tomato varieties from various regions worldwide, with mean values ranging from 0.11 to 1.07 mg·100 g-1 F.W (Abushita et al., 2000; Scalzo et al., 2005).

5. CONCLUSIONS

Our study demonstrates that Darsirius exhibits remarkable ecological plasticity, consistently yielding well in both organic and conventional farming systems. Regal, being a long pepper cultivar, displayed uniform and substantial yields, while also maintaining high nutritional values in both growing systems. Moreover, Rebeca showcased impressive tolerance to pest pathogens, showcasing stable yields in the studied systems. These findings highlight the resilience and potential of these cultivars for successful cultivation in various agricultural settings. Furthermore, we recommend conducting further studies spanning multiple consecutive years to thoroughly assess the adaptability of the selected cultivars to the specific challenges posed by organic crop production. Presently, our ability to conclusively determine their suitability for organic farming is limited until these cultivars undergo testing for more extended periods within organic systems. Only through comprehensive and prolonged investigations we can gain a comprehensive understanding of their performance and potential in organic agricultural environments.

ACKNOWLEDGMENTS

The study was financially supported by Ministry of Agriculture and Rural Development, AFIR – "*Research studies applied on organic agriculture – a pilot project*".

REFERENCES

1. Abushita, A.A.; Daood, H.G.; Biacs, P.A., 2000. Change in carotenoids and antioxidant vitamins in tomato as a function of varietal and technological factors. J. *Agric. Food Chem*., 48, 2075–2081.
2. Agarwal, S.; Rao, A.V., 2000. Tomato lycopene and its role in human health and chronic diseases. *CMAJ*, 163, 739–744.
3. Alsina, I., Erdberga, I., Duma, M., Alksnis, R., & Dubova, L., 2022. Changes in greenhouse grown tomatoes metabolite content depending on supplemental light quality. *Frontiers in Nutrition*, 9.
4. AOAC. Official Methods of Analysis of AOAC International, 17th ed.; AOAC: *Gaithersburg, MD, USA, 2000.*
5. AOAC. Official Method 930.04 Moisture in Plants. *Official Methods of Analysis of AOAC International*, 2005.
6. AOAC. Official Methods of Analysis of AOAC International, 21st ed.; AOAC: *Gaithersburg, MD, USA, 2005.*
7. Araujo, C.J.; Silva, P.; Telhado, S.; Sakai, R.; Spoto, M.; Melo, P., 2014. Physico-chemical and sensory parameters of tomato cultivars grown in organic systems. *Hortic. Bras*., 32, 205–209.
8. Barcanu-Tudor, E., Vinatoru, C., Zamfir, B., Bratu, C. and Draghici, E.M., 2020. Quantitative and qualitative attributes of two new bell pepper cultivars 'Ideal' and 'Carmin', grown in conventional and organic farming systems. *Acta Hortic*. 1292, 45-52 DOI: 10.17660/ActaHortic.2020.1292.6
9. Beckles, D. M., 2012. Factors affecting the postharvest soluble solids and sugar content of tomato (*Solanum lycopersicum* L.) fruit. *Postharvest Biology and Technology*, *63*(1), 129-140.
10. Brezeanu, C., Robu, T., Trofin, A. E., Brezeanu, P. M., Murariu, F., & Murariu, O. C., 2020. Research on the physico–chemical characterization of improved genotypes for *Lycopersicon esculentum* Mill. obtained in the ecological system. *Lucrări Ştiinţifice* – vol. 63(1), *seria Agronomie*
11. Brezeanu, C, Brezeanu, PM, Stoleru, V, Irimia, LM, Lipșa, FD, Teliban, GC, Murariu, OC, 2022. Nutritional value of new sweet pepper genotypes grown in organic system. *Agriculture*, 12 (11), 1863.
12. Conforti, F.; Statti, G.A.; Menichini, F., 2007. Chemical and biological variability of hot pepper fruits (*Capsium annuum* var. *acuminatum* L.). *Food Chem.*, *102*, 1096–1104
13. European Commission official website, 2014.
14. Farneti, B.; Schouten, R.E.; Woltering, E.J., 2012. Low temperature-induced lycopene degradation in red ripe tomato evaluated by remittance spectroscopy. *Postharvest Biol. Technol*., 73, 22–27
15. Figueroa, CIE, Martínez, DMT, Rodríguez, PJE, Cruz T, Beryl CLMT, Valle, GS, Ramírez, RSP, 2015. Antioxidant capacity in varieties of black pepper (*Capsicum annuum* L). *Interciencia*, 40, 696–703.
16. Flores-Velazquez, J, Mendoza-Perez, C, Rubiños-Panta, JE, Ruelas-Islas, JDR, 2022. Quality and yield of bell pepper cultivated with two and three stems in a modern agriculture system. *Horticulturae, 8(12), 1187*
17. Fortea, C.; Antohi, V.M.; Zlati, M.L.; Ionescu, R.V.; Lazarescu,I.; Petrea, S.M.; Cristea, D.S., 2022. The dynamics of the implementation of organic farming in Romania. *Agriculture* 2022, 12, 774.

18. Fray, R.G.; Grierson, D., 1993. Identification and genetic analysis of normal and mutant phytoene synthase genes of tomato by sequencing, complementation and co-suppression. *Plant Mol. Biol*., 22, 589–602.

19. Hallmann, E.; Rembialkowska, E., 2012. Characterization of antioxidant compounds in sweet bell pepper (*Capsicum annuum* L.) under organic and conventional growing systems. *J. Sci. Food Agric*., 92, 2409–2415.

20. Ilic, Z.; Nikolaos, K.; Ljubomir, S., 2014. Tomato fruit quality from organic and conventional production. In *V. Pilipavicius, Organic Agriculture towards Sustainability; Tech Europe: Rijeka*, Croatia; pp. 147–169

21. Khan, M. M. A., Bhardwaj, G., Naeem, M., Mohammad, F., Singh, M., Nasir, S., & Idrees, M., 2008. Response of tomato (*Solanum lycopersicum* L.) to application of potassium and triacontanol.In *XI International Symposium on the Processing Tomato 823* (pp. 199-208).

22. Kurina AB, Solovieva AE, Khrapalova IA, Artemyeva AM., 2021. Biochemical composition of tomato fruits of various colors. *Vavilovskii Zhurnal Genet Selektsii*.25:514–27. doi: 10.18699/VJ21.058

23. Lammerts van Bueren, E., S. S. Jones, L. Tamm, K. M. Murphy, Myers J. R., C. Leifert, and M. M. Messmer, 2010. The need to breed crop varieties suitable for organic farming, using wheat, tomato and broccoli as examples: a review. *NJAS—Wageningen Journal of Life Sciences* 58:193–206.

24. Lana MM, Tijskens LMM, Van Kooten O., 2005. Effects of storage temperature and fruit ripening on firmness of fresh cut tomatoes. *The Netherands. Posth Biol Technol*;35:87–95. DOI: 10.1016/j.postharvbio.2004.07.001

25. Loschenberger, F., A. Fleck, H. Grausgruber, H. Hetxendorfer, G. Hof, J. Lafferty, M. Marn, A. Neumayer, 2008. Breeding for organic agriculture: The example of winter wheat in Austria. *Euphytica* 163:469–480.

26. Malundo, T. M. M., Shewfelt, R. L., & Scott, J. W., 1995. Flavor quality of fresh tomato (*Lycopersicon esculentum* Mill.) as affected by sugar and acid levels. *Postharvest Biology and Technology*, *6* (1-2), 103-110.

27. Manole, V., Draghici, M., Stoian, M., Ladaru, R., Ion R., Sandu, R., Turek, M., 2009. Piaţa produselor agroalimentare în România – tradiţionale şi ecologice, *Tribuna Economica*, Bucuresti.

28. Mason, H. E., and D. Spaner. 2006. Competitive ability of wheat in conventional and organic management systems: A review of the literature. *Canadian Journal of Plant Science* 86:333–343.

29. Ministery of Agriculture and Rural Development Romania. www.madr.ro

30. Murariu, O.C.; Brezeanu, C.; Jităreanu, C.D.; Robu, T.; Irimia, L.M.; Trofin, A.E.; Popa, L.-D.; Stoleru, V.; Murariu, F.; Brezeanu, P.M., 2021. Functional quality of improved tomato genotypes grown in open field and in plastic tunnel under organic farming. *Agriculture, 11,609.*

31. Nagata M., Yamashita I., 1992. Simple method simultaneous determination of chlorophyll and carotenoids in tomato fruit. *Nippon Shokuhin Kogyo Gakkaishi 39* (10), 925–928 https://doi.org/10.3136/nskkk1962.39.925

32. Palacio, MA, Sánchez, CE, 2017. Influence of the variety, rootstock and harvest time on the quality and maturity rates in black pepper. *Nova Sci.* 9, 1–23.

33. Pankratov, I.; McQuinn, R.; Schwartz, J.; Bar, E.; Fei, Z.; Lewinsohn, E.; Zamir, D.; Giovannoni, J.J.; Hirschberg, J., 2016. Fruit carotenoid-deficient mutants in tomato reveal a function of the plastidial isopentenyl diphosphate isomerase (IDI1) in carotenoid biosynthesis. *Plant Journal*, 88, 82–94.

34. Reid, T. A., R.-C. Yang, D. F. Salmon, A. Navabi, and D. Spaner. 2011. Realized gains from selection for spring wheat grain yield are different in conventional and organically managed systems. *Euphytica* 177:253–266.

35. Ribes-Moya, A, Raigón, M, Moreno-Peris, Estel, A, Fita, A, Rodríguez-Burruezo, A, 2018, Response to organic cultivation of heirloom *Capsicum* peppers: Variation in the level of bioactive compounds and effect of ripening. *PLoS ONE*. Doi: 10.1371/journal.pone.0207888.

36. Scalzo, J.; Politi, A.; Pellegrini, N.; Mezzetti, B.; Battino, M., 2005. Plant genotype affects total antioxidant capacity and phenolic content in fruit. *Nutrition*, 21, 207–213.

37. Stoica, G. D., Sterie, M. C., Giucă, A. D., Ursu, A., & Petre, I. L., 2022. Trends in organic farming in Romania. *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development*, 22(3). pp.725-731.

38. Tigist, M., Workneh, T. S., & Woldetsadik, K., 2013. Effects of variety on the quality of tomato stored under ambient conditions. *Journal of food science and technology*, 50(3), 477-486. DOI:10.1007/s13197-011-0378-0.

39. Wortman S. E., Francis C. A., Galusha T. D., Chris Hoagland, Justin Van Wart, P. Stephen Baenziger, Thomas Hoegemeyer & Maury Johnson, 2013. Evaluating cultivars for organic farming: maize, soybean, and wheat genotype by system interactions in Eastern Nebraska, *Agroecology and Sustainable Food Systems*, 37:8, 915-932

40. Soare, R, Dinu, M, Băbeanu, C, Popescu, M, Popescu, A, 2017, Nutritional value and antioxidant activities in fruit of some cultivars of pepper (*Capsicum annuum* L.). *Journal of Agroalimentary Processes and Technologies*, 23(4), 217-222.

41. Vance, T. M., Su, J., Fontham, E. T., Koo, S. I., & Chun, O. K., 2013. Dietary antioxidants and prostate cancer: a review. *Nutrition and cancer*, *65*(6), 793-801.

42. Yoo, H. J., Park, W. J., Lee, G. M., Oh, C. S., Yeam, I., Won, D. C., & Lee, J. M., 2017. Inferring the genetic determinants of fruit colors in tomato by carotenoid profiling. *Molecules*, *22*(5), 764.