COMPREHENSIVE EVALUATION OF COCKTAIL-TYPE TOMATO HYBRIDS UNDER EXTENDED-CYCLE CULTIVATION IN "RICHEL" PLASTIC GREENHOUSES BASED ON BIOMETRIC TRAITS, YIELD, AND ECONOMIC EFFICIENCY

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Abstract. Cocktail-type tomato hybrids occupy a significant niche in modern greenhouse production due to their balanced combination of yield, fruit quality, and marketability. However, in Ukraine, their cultivation under extended-cycle conditions in winter plastic greenhouses remains insufficiently studied, particularly regarding the integrated assessment of modern hybrids under commercial production systems. *Purpose.* The aim of the study was to determine growth and development patterns, yield formation, and economic performance of cocktail-type tomato hybrids under extended-cycle cultivation in "Richel" plastic greenhouses. *Methodology.* The research was conducted in 2023–2025 at a high-tech commercial greenhouse enterprise using low-volume hydroponics on mineral wool substrate (Grodan GT Master) with automated climate and fertigation control (Priva Integro). The experimental material included four hybrids: Torelino F_1 (control), Briozo F_1, Rexoso F_1, and Valerioso F_1. The study evaluated interphase developmental periods, key biometric traits, yield level and dynamics, and economic efficiency. *Results.* Significant

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genotype-dependent differences were identified in developmental timing, plant architecture, productivity, and economic performance. Briozo F_1 and Rexoso F_1 exhibited earlier fruiting onset and a shorter "emergence–fruiting" period compared to the control. Rexoso F_1 demonstrated superior biometric performance, exceeding the control by 4.3% in stem length, 9.9% in fruit number per plant, 11.0% in fruits per truss, 23.4% in average truss weight, and 15.9% in average fruit weight. Briozo F_1 showed enhanced vegetative growth, whereas Valerioso F_1 performed at or below the control level for most biometric traits. The highest yield was recorded for Rexoso F_1 (27.3 kg m^{-2}), representing a 15.2% increase over the control (23.7 kg m^2) with high interannual stability. Yield advantages of Briozo F_1 and Valerioso F_1 reached 7.2% and 3.8%, respectively. Economic analysis confirmed the superiority of high-performing hybrids. Rexoso F_1 achieved the highest economic indicators, including revenue of 3080.8 UAH m^2, net profit of 910.5 UAH m^2, and profitability of 42.0%, compared with 2592.2 UAH m^2, 477.0 UAH m^2, and 22.6%, respectively, for the control. *Practical implications.* The results can be used by commercial greenhouse enterprises when selecting cocktail-type tomato hybrids for extended-cycle production. The cultivation of Rexoso F_1 under the studied technological conditions can increase biological productivity and improve the economic efficiency of greenhouse tomato production. *Originality/Value.* This study provides a comprehensive three-year evaluation of modern cocktail-type tomato hybrids under extended-cycle cultivation in commercial plastic greenhouses, a production system that remains insufficiently represented in Eastern European research. The findings demonstrate the decisive role of genotype in determining both biological productivity and economic returns and identify Rexoso F_1 as the most promising hybrid for commercial implementation under the studied conditions.

INTRODUCTION

The tomato (*Solanum lycopersicum* L.) is a leading vegetable crop in global agricultural production, characterized by consistently high demand for both fresh consumption and processing [8]. Global tomato production in 2022 amounted to approximately 186 million tonnes and is projected to rise to 190–200 million tonnes by 2025, necessitating improvements in cultivation technology efficiency [6].

In the context of modern intensive greenhouse vegetable production, the cultivation of tomatoes in extended-cycle systems has gained significant prominence; this practice is most widely implemented in the Netherlands, where high-tech production systems utilizing first-generation (F_1) hybrids are employed. Such hybrids ensure a high degree of heterosis expression, stable yields, a prolonged fruiting period, and superior product quality [10; 11].

Cocktail-type tomato hybrids hold a special place in greenhouse production, offering an optimal balance between yield and product quality [9]. They are characterized by a fruit weight of 30–50 g, dense clusters, prolific fruit set (8–14 fruits per cluster), uniform ripening, and excellent flavor profiles – attributes that drive their significant share of production in European countries, particularly the Netherlands [7; 17].

However, for Ukraine, the cultivation of cocktail-type tomatoes in extended-cycle industrial winter greenhouses remains a relatively new practice that has not yet gained widespread adoption. Existing scientific information on this subject is limited and fragmentary, with most studies focusing on isolated aspects of tomato cultivation rather than providing a comprehensive evaluation of modern hybrids under specific domestic production conditions.

Furthermore, the international market offers a range of high-yielding cocktail-type tomato hybrids from leading breeding companies – such as *Rijk Zwaan, Bayer, and Enza Zaden* – that are widely used in European greenhouse production. However, their yield potential, growth and development characteristics, and the economic efficiency of their cultivation in Ukrainian winter greenhouses remain insufficiently studied.

Thus, there is a pressing need for a comprehensive evaluation of cocktail-type tomato hybrids based on biometric parameters, yield, and economic efficiency within an extended cultivation cycle in “Richel” film greenhouses; this need underscores the scientific and practical significance of the present study.

1. Agro-Biological Potential of Cocktail-Type Tomato Cultivation

In the European Union, total tomato production amounts to approximately 16.8 million tonnes annually, with Italy, Spain, and Portugal being the largest producers [12]. Cocktail and cherry-type hybrids make up a large

portion of contemporary greenhouse production; these are most common in nations with highly developed protected-cropping industries, especially the Netherlands, Spain, and Belgium [16]. Turkey is a leading global tomato producer, with an output of approximately 14.6 million tonnes in 2024 [6]. The cultivation of cocktail and cherry hybrids represents a key segment of greenhouse vegetable production, accounting for an estimated 10–17% of total output [18]. A substantial portion of the produce is exported, and Turkey ranks among the top three global exporters of cherry tomatoes [15].

In the Dutch commercial production of cocktail-type tomatoes, widely used hybrids include those from companies such as *Rijk Zwaan* (*Brioso* F_1, *Tatami* F_1), *Bayer* (*Torelino* F_1, *Kurtino* F_1), *Enza Zaden* (*Campari* F_1, *Annamay* F_1, *Devotion* F_1), *Axia* (*Araxi* F_1, *Rosannax* F_1), and others [2; 5].

In recent years, high-tech greenhouse complexes in Ukraine have shown a steady trend toward diversifying their tomato product ranges, accompanied by a gradual shift away from the traditional production structure that focused primarily on medium- and large-fruited varieties. One of the key factors driving the transformation of product assortment policies is the increase in imports from neighboring countries (such as Turkey); this intensifies domestic market competition and compels domestic producers to expand their product ranges [4]. Against this backdrop, modern greenhouse enterprises are developing diversified product portfolios that encompass several tomato morphotypes. Specifically, the production operations of PJSC “Kombinat 'Teplychnyi” (Kyiv region) include the following groups: red medium-fruited, pink large-fruited, yellow large-fruited, red plum-shaped, and cocktail-type tomatoes [13].

From 2021 to 2024, cocktail-type tomatoes were grown in more and more high-tech greenhouse complexes in Ukraine. This was done because they are very popular in the market and produce a steady amount of tomatoes. Notable among the hybrids widely adopted in winter greenhouses are Brioso F_1 and Campari F_1, both of which are characterized by high yield potential. Under intensive cultivation practices involving an extended growing cycle (with a vegetation period exceeding 300 days and a fruiting period of over 230 days), these hybrids achieve average yields of 27–39 kg/m². Nevertheless, the total cultivation area for these hybrids in Ukraine remains limited. For instance, at PrJSC “Kombinat Teplychnyi”,

they cover approximately 1.5 hectares; at POSP "Umanskyi Teplychnyi Kombinat", 2 hectares; at the "Dnipro" Greenhouse Complex, 3 hectares; and at LLC TK "Dniprovskyi", 0.5 hectares.

By comparison, leading greenhouse operations in the Netherlands – cultivating Brioso F_1 hybrids using intensive technology with supplemental lighting and a fruiting period exceeding 250 days – achieve yields of 39–42 kg/m², indicating significant potential for improving production efficiency in Ukraine [7; 14].

2. Purpose, Materials and Methods of the Research Conducted

The purpose of the study is to conduct a comprehensive assessment of tomato hybrids with cocktail-type fruits in conditions of extended turnover of film greenhouses of the "Richel" type according to biometric indicators of plant growth and development, yield level and indicators of economic efficiency of their cultivation in order to determine the most productive and economically feasible for introduction into production.

Research materials and methods. The study was conducted from 2023 to 2025 at the high-tech greenhouse facility "Dniprovskyi" Greenhouse Complex. The experimental phase took place in "Richel"-type winter plastic greenhouses with the following structural specifications: span width – 12 m; column height from foundation to gutter – 6.0 m (total greenhouse height – 9.6 m); column spacing – 4.0 m; and trellis height from the substrate level – 4.0 m.

3. Technological Aspects of Growing Cocktail-Type Tomatoes

The tomato plants were cultivated using a low-volume hydroponic method with "Grodan GT Master" stone wool substrate. Greenhouse microclimate parameters (air temperature, relative humidity, ventilation intensity, and carbon dioxide concentration) were maintained automatically via computerized control systems. The "Priva Integro" computer control system managed plant nutrition by controlling the pH levels, concentrations of nutrients, and how often and how much they were given. This made sure that the plants got the right nutrients for their needs and that the substrate had the right amount of water and nutrients.

The study focused on cocktail-type tomato hybrids – Torelino F_1 (*Bayer*), Brioso F_1, Rexoso F_1, and Valerioso F_1 (*Rijk Zwaan*) [2; 5] – which were

grouped together based on a combination of morphological, biological, and economically valuable traits. These hybrids are indeterminate, cluster-type cocktail tomatoes intended for greenhouse cultivation, specifically for extended cropping cycles and intensive production systems utilizing supplemental artificial lighting.

The plants exhibit vigorous growth and a well-balanced ratio of vegetative to generative development, ensuring consistent formation of reproductive organs throughout the growing season. Relatively short internodes facilitate compact cluster placement and improve light penetration while the foliage is well-developed. The fruit clusters are regular and symmetrical, with a high fruit-set rate. Each cluster typically bears 10–14 fruits, ensuring high marketability. The fruits are round and uniform, with an average weight of 35–45 g, an intense red color, and a smooth, glossy surface. The flesh is firm and juicy, with a high soluble solids content (6.5–7.5 *Brix*), resulting in excellent flavor and high taste ratings. The hybrids are characterized by high fruit firmness, ensuring good transportability and shelf life, as well as suitability for sale either as individual fruits or in whole clusters. A key agronomic trait is the uniform ripening of fruit within the cluster, which facilitates harvesting and reduces labor costs.

Production and experimental data indicate that the hybrid begins fruiting early and has a prolonged fruiting period, ensuring a high total yield in extended cropping cycles. It consistently produces a high volume of marketable fruit due to fruit uniformity and a low percentage of non-standard produce.

The hybrids possess genetic resistance to major tomato diseases, specifically tomato mosaic virus, Fusarium wilt, Verticillium wilt, and Cladosporium leaf mold.

The experimental design followed a randomized layout with four replications. The area of the recorded plot was 10 m^2, the total plot area was 14 m^2, and the total experimental area was 224 m^2.

Seeds were sown in polystyrene trays filled with a mineral wool substrate. At 12 days of age, seedlings were pricked out into double "Begrow" mineral wool cubes (15×10×6.5 cm). At 31 days of age, the plants were transplanted to their permanent location in the greenhouse. At the time of transplanting, the seedlings were at the 10-true-leaf stage. The plant spacing was 1.6×0.25 m, with four plants placed on each "Grodan

GT Master" mineral wool substrate slab (100×20×7.5 cm), corresponding to a substrate volume of 3.75 L per plant. The initial planting density was 2.5 plants/m^2, with subsequent training to achieve a density of 3.7 stems/m^2. The number of plants per recorded plot was 25.



Figure 1. Visual representation of the cocktail-type tomato hybrids under study during the research period

Source: compiled by the author

Plant cultivation was carried out according to the recommended technology for winter greenhouses. Plant training and care were performed in accordance with standard intensive tomato cultivation practices for

protected ground conditions. Harvesting took place throughout the fruiting period (March–November), three times a week, in compliance with the requirements of DSTU 3246–95 [3]. Data recording and observations during the experiment were conducted in accordance with generally accepted methodologies, specifically the "Methodology of Experimental Work in Vegetable and Melon Growing" [1].

Economic efficiency was determined based on the value of the produce obtained and the additional production costs, calculated separately for each experimental variant using actual data.

4. Phenological Development of Cocktail-Type Tomato Hybrids

Throughout the 2023–2025 study period, the progression of key phenological growth and development phases was recorded. No significant differences were observed between the study years, indicating stable growing conditions and result reproducibility. Analysis of the duration of phenological phases showed that the initial stages of organogenesis (sowing, mass emergence, pricking out, seedling spacing, and greenhouse transplanting) occurred synchronously across all studied hybrids (December 15 – January 18), ensuring uniform starting conditions for plant (seedling) growth and development. A comparative assessment of interphase periods revealed genotypic differences regarding the onset of reproductive phases. Specifically, the Brioso F_1 and Rexoso F_1 hybrids began fruiting on March 26 – six days earlier than the control (Torelino F_1: April 1) – with the "emergence to onset of fruiting" period lasting 98 days compared to 103 days for the control. For the Valerioso F_1 hybrid, the onset of fruiting was recorded on April 5, resulting in an extended interphase period of 108 days (Table 1).

A similar trend was observed regarding the onset of mass fruiting: for the Brioso F_1 and Rexoso F_1 hybrids, it occurred on April 2 (3 days earlier than the control, which was April 5), whereas for Valerioso F_1 it was April 10. Consequently, the duration of the "emergence to mass fruiting" period was shortest for Brioso F_1 and Rexoso F_1 (105 days, or 3 days less than the control's 108 days) and longest for Valerioso F_1 (113 days, or 5 days longer).

The fruiting period for the control hybrid was 220 days. For the Brioso F_1 and Rexoso F_1 hybrids, it was longer – 225 days (an increase of 5 days) – while for Valerioso F_1 it was shorter, at 215 days.

Table 1

Characteristics of the duration of phenological growth and development phases of cocktail-type tomato hybrids (average for 2023–2025)

Duration of phenological phases	Hybrid			
	Torelino F_1 (c)	Brioso F_1	Rexozo F_1	Valerioso F_1
Sowing	15.12.	15.12.	15.12.	15.12.
Mass emergence (75%)	18.12.	18.12.	18.12.	18.12.
Pricking out	30.12.	30.12.	30.12.	30.12.
Seedling spacing: 21 plants/m²	06.01.	06.01.	06.01.	06.01.
Planting seedlings in the greenhouse	18.01.	18.01.	18.01.	18.01.
Onset of fruiting	01.04.	26.03.	26.03.	05.04.
Mass fruiting	05.04.	02.04.	02.04.	10.04.
Removal of the growing point	10.09.	10.09.	10.09.	10.09.
Last harvest	06.11.	06.11.	06.11.	06.11.
Plant death	07.11.	07.11.	07.11.	07.11.
Period from emergence to fruiting, days	103	98	98	108
Period from emergence to mass fruiting, days	108	105	105	113
Fruiting period, days	220	225	225	215
Vegetation period, days	330	330	330	330

Source: compiled by the author

The total duration of the growing season was identical for all hybrids studied – 330 days – indicating stability in the progression of key plant growth and development phases under the experimental conditions.

5. Evaluation of Biometric Characteristics of Cocktail-Type Tomato Hybrids

Research conducted during 2023–2025 revealed significant differences in morphobiometric characteristics among cocktail-type tomato hybrids compared to the control, Torelino F_1. The main stem length of the control variant was 973.2 cm. Greater growth was observed in the Brioso F_1 (1021.2 cm) and Rexoso F_1 (1015.1 cm) hybrids, exceeding the

control by 48.0 cm and 41.9 cm, respectively, whereas Valerioso F_1 showed a value comparable to the control (970.2 cm). Regarding the number of leaves per plant, the Brioso F_1 hybrid performed best with 111.1 leaves, exceeding the control by 4.2 leaves. The Rexoso F_1 hybrid exceeded the control by 2.8 leaves, while Valerioso F_1 showed a lower value of 104.6 leaves (Table 2).

Table 2

Biometric characteristics of cocktail-type tomato hybrids (average for 2023–2025)

Biometric plant measurement parameters	Hybrid				NIR $_{0,05}$
	Torelino F_1 (c)	Brioso F_1	Rexozo F_1	Valerioso F_1	
Total length of the main stem over the entire growing season, cm	973,2	1021,2	1015,1	970,2	13,5-18,6
Number of leaves on the plant over the entire growing season, pcs.	106,9	111,1	109,7	104,6	4,08-6,19
Flowering clusters over the entire growing season, pcs.	28,6	29,1	28,9	28,1	0,47-0,87
Clusters from which fruit was harvested over the entire fruiting period, pcs.	26,1	27,3	26,5	25,7	0,76-1,01
Number of fruits per plant over the entire fruiting period, pcs.	246,6	254,2	271,1	237,1	1,51-4,60
Number of fruits per cluster, pcs.	9,1	9,4	10,1	9,3	0,28-0,44
Average weight of a bunch with fruits for the entire fruiting period, g	293,1	316,2	361,8	309,3	5,04-8,01
Average fruit weight for the entire fruiting period, g	31,4	32,7	36,4	31,6	0,86-1,49

Source: compiled by the author

Plants of the Torelino F_1 hybrid (control) produced 28.6 flowering clusters. A slight increase in this indicator was observed in the Brioso F_1 (29.1 clusters) and Rexoso F_1 (28.9 clusters) hybrids, whereas it was somewhat lower in Valerioso F_1 (28.1 clusters). A similar trend was noted

regarding the number of productive clusters: Brioso F_1 produced 27.3 clusters and Rexoso F_1 produced 26.5 clusters –figures exceeding the control (26.1 clusters) – while Valerioso F_1 showed a lower value (25.7 clusters).

The highest number of fruits was produced by the Rexoso F_1 hybrid (271.1 fruits), exceeding the control by 24.5 fruits. For the Brioso F_1 hybrid, this figure was 254.2 fruits, while for Valerioso F_1 it was 237.1 fruits. It was determined that the number of fruits per cluster was also highest in the Rexoso F_1 hybrid (10.1 fruits), exceeding the control by 1.0 fruit.

Significant differences between the hybrids were found regarding the mass of the fruit-bearing cluster and the mass of the fruits themselves. The Rexoso F_1 hybrid produced the highest average mass per fruit-bearing cluster (361.8 g), exceeding the control by 68.7 g. For the Brioso F_1 and Valerioso F_1 hybrids, this figure was 316.2 g and 309.3 g, respectively. The average weight of a single fruit was highest for the Rexoso F_1 hybrid – 36.4 g, which is 5.0 g higher than the control – whereas for Brioso F_1 and Valerioso F_1, it was 32.7 g and 31.6 g, respectively.

6. Yield and Marketability of Cocktail-Type Tomato Hybrids

A comparative assessment of interphase periods revealed significant genotypic differences in the timing of reproductive phases, which determined specific patterns of yield formation. The Brioso F_1 and Rexoso F_1 hybrids were characterized by an earlier onset of fruiting – at 98 days (late March) – which was 6 days earlier than the control (Torelino F_1: April 1, 103 days). In contrast, the Valerioso F_1 hybrid entered the fruiting phase later – on April 5, or at 108 days. The early onset of fruiting in the Brioso F_1 and Rexoso F_1 tomato hybrids resulted in early yield formation as early as March (0.3 kg/m^2), whereas no produce was obtained from the control (Torelino F_1) or Valerioso F_1 during this period. A similar trend was observed regarding the onset of mass fruiting: Brioso F_1 and Rexoso F_1 hybrids reached this stage on April 2 (105 days), the Torelino F_1 control on April 5 (108 days), and Valerioso F_1 on April 10 (113 days). Yield figures equalized in April (2.6–2.9 kg/m^2); however, the early-maturing hybrids maintained their advantage thereafter (Fig. 2).

During the period of intensive fruiting (May–August), significant differences were observed among the hybrids regarding the realization of yield potential compared to the control. The control hybrid (Torelino F_1)

produced yields of 3.2–3.6 kg/m², whereas Rexoso F_1 consistently outperformed it by 0.5 kg/m² in June (4.0 vs. 3.5 kg/m²) and by 0.7 kg/m² in July (4.3 vs. 3.6 kg/m²); it also maintained this advantage in August, indicating greater intensity and duration of summer fruiting. The Brioso F_1 hybrid showed consistently higher or near-control performance (3.7–3.8 kg/m² during the summer months), exceeding the control by 0.1–0.3 kg/m². Valerioso F_1 produced yields comparable to the control (3.5–3.6 kg/m²); while it lagged in intensity, it was characterized by more uniform yield dynamics.

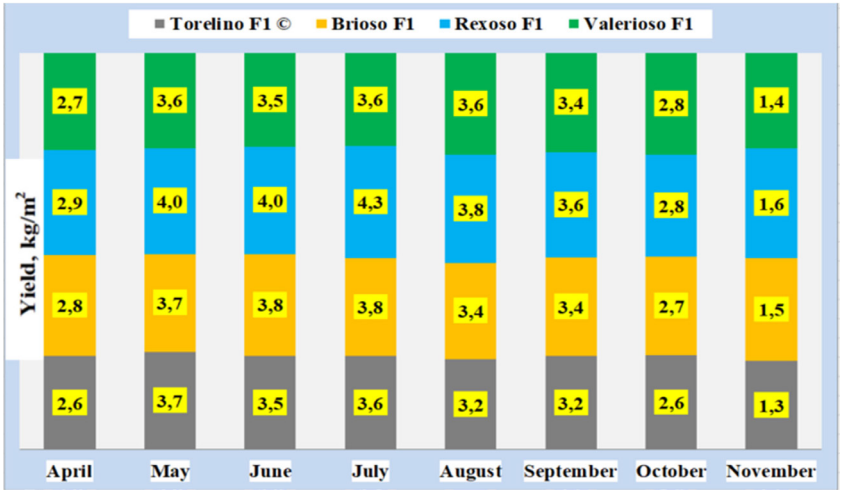


Figure 2. Dynamics of yield formation in cocktail-type tomato hybrids, averaged over 2023–2025

Source: compiled by the author

During the autumn fruiting period (September–November), yield dynamics followed a distinct month-by-month pattern determined by both the biological characteristics of the hybrids and the cultivation techniques employed. In September, despite the transition to autumn, fruiting levels remained relatively high due to the removal of the growing point, which facilitated the redistribution of assimilates toward the filling of established fruit clusters (up to 8–9 clusters per plant). Under these conditions, the

Rexoso F_1 hybrid achieved a higher yield of 3.6 kg/m², exceeding the control (Torelino F_1 – 3.2 kg/m²) by 0.4 kg/m². The Brioso F_1 hybrid also showed a higher figure – 3.4 kg/m² (+0.2 kg/m² compared to the control), whereas Valerioso F_1 produced a yield of 3.2 kg/m², showing virtually no difference from the control.

Yields in October showed a significant decline, driven by reduced solar radiation and limited photosynthetic activity. For the Torelino F_1 tomato hybrid (control), the yield dropped to 2.0 kg/m², while Rexoso F_1 maintained a higher level at 2.4 kg/m² (+0.4 kg/m²) and Brioso F_1 at 2.2 kg/m² (+0.2 kg/m²). The Valerioso F_1 hybrid produced a yield of 2.1 kg/m², exceeding the control only slightly.

In November, fruiting concluded during the first ten-day period (November 6), with the final harvest consisting of fruit that had set earlier. Yields during this period were minimal: 1.3 kg/m² for the control (Torelino F_1), while Rexoso F_1 plants produced 1.6 kg/m² (+0.3 kg/m²), Brioso F_1 produced 1.5 kg/m² (+0.2 kg/m²), and Valerioso F_1 produced 1.4 kg/m² (+0.1 kg/m²). An analysis of the total yield data for cocktail-type tomato hybrids from 2023 to 2025 reveals differences among the hybrids regarding both productivity levels and the stability of yield formation throughout the fruiting period (Table 3).

In European Union countries, high standards apply to tomato fruit quality, particularly regarding marketability. For cocktail-type tomato hybrids grown under intensive greenhouse conditions, a marketability level of at least 94–95% is considered optimal, while values exceeding 96% indicate a high degree of realization of the crop's production potential [5].

The Torelino F_1 tomato hybrid (control) produced an average yield of 23.7 kg/m². During the study period, there were minor fluctuations in yield figures across the years (22.8–24.3 kg/m²), characterizing it as relatively stable but with limited productivity potential. The highest yield was recorded for the Rexoso F_1 hybrid – an average of 27.3 kg/m² over three years – which significantly exceeded the control by 3.6 kg/m² (15.2%). Furthermore, year-to-year variation was minimal (27.1–27.4 kg/m²), indicating high environmental plasticity and stability in the expression of the hybrid's economically valuable traits. Plants of the Brioso F_1 hybrid produced an average yield of 25.4 kg/m², representing a gain of 1.7 kg/m² (7.2%) over the control. However, a decrease to 23.8 kg/m² was noted in

2025, which may indicate a certain sensitivity of the genotype to adverse abiotic factors. The Valerioso F_1 tomato hybrid produced a yield of 24.6 kg/m², exceeding the control by 0.9 kg/m² (3.8%), with annual yields ranging from 24.3 to 25.0 kg/m².

Table 3

Total yield of cocktail-type tomato hybrids over the entire fruiting period

Hybrid	Yield, kg/m²				Yield increase	
	2023	2024	2025	average yield	kg/m²	%
Torelino F_1 (c)	24,3	24,1	22,8	23,7	0,0	0,0
Brioso F_1	26,1	26,3	23,8	25,4	1,7	7,2
Rexozo F_1	27,3	27,4	27,1	27,3	3,6	15,2
Valerioso F_1	25,0	24,4	24,3	24,6	0,9	3,8
NIR, $_{05}$ kg/m²	0,15	0,55	0,56			

Source: compiled by the author

Research results demonstrated that all the cocktail-type tomato hybrids studied maintained a high level of fruit marketability throughout 2023–2025; annual variability was minimal, indicating production stability under the given growing conditions. In the control variant (Torelino F_1), fruit marketability ranged from 92.9% to 93.8% (mean: 93.3%), characterizing it as a relatively stable genotype, albeit one that was less effective in terms of this specific metric. Significantly higher marketability was observed in the Rexozo F_1 hybrid, with values ranging from 95.9% to 96.8% and an average of 96.3% – exceeding the control by 3.0%. The Brioso F_1 hybrid also showed high performance, averaging 94.8% and surpassing the control by 1.5% (Fig. 3).

In contrast, the fruit of the Valerioso F_1 hybrid exhibited a marketability level close to that of the control variant (93.2–93.6%), with a mean value of 93.4% and a minimal increase (+0.1%), indicating the absence of significant genotypic advantages regarding this parameter.

Summarizing the results, it should be noted that the formation of fruit marketability is largely determined by the genotypic characteristics of the hybrids.

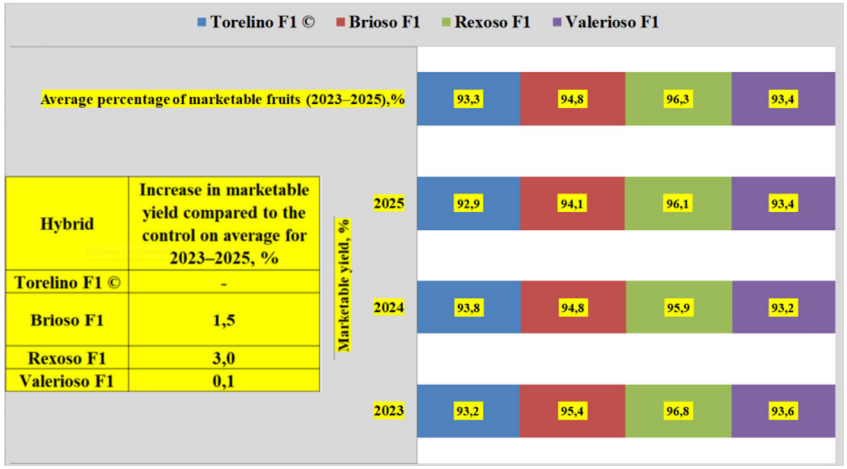


Figure 3. Overall marketability of cocktail-type tomato fruits over the entire fruiting period

Source: compiled by the author

7. Economic Efficiency of Growing Cocktail-Type Tomatoes

The results of the economic assessment of growing cocktail-type tomato hybrids, averaged over the 2023–2025 period, indicate significant variation in efficiency indicators depending on the genotype, manifested in differences in yield, revenue, and profitability levels.

The highest yield was achieved by the Rexoso F_1 hybrid (27.3 kg/m²), resulting in a maximum revenue of 3,080.8 UAH/m². The Brioso F_1 hybrid produced 25.4 kg/m² with a revenue of 2,830.4 UAH/m², while Valerioso F_1 yielded 24.6 kg/m² with a revenue of 2,683.4 UAH/m². The control variant (Torelino F_1) showed the lowest figures: 23.7 kg/m² and 2,592.2 UAH/m². The average selling price of the produce in the trial was virtually uniform (116.8–117.5 UAH/kg), ruling it out as a decisive factor in the differences in revenue levels.

The cost structure remained relatively stable across most categories. Specifically, costs for energy (921.5 UAH/m²), raw materials and supplies (312.4 UAH/m²), as well as fixed and other expenses (97.8 and 105.2 UAH/m², respectively), remained constant across the variants.

However, labor costs (511.2–548.9 UAH/m²) and expenses for packaging, logistics, and marketing (167.1–184.5 UAH/m²) tended to increase in variants with higher yields, driven by the greater volume of produce. Consequently, total production costs ranged from 1,745.1 to 1,782.8 UAH/m², while the full cost of production amounted to 2,115.2–2,170.3 UAH/m². The highest values for these indicators were observed in the Reksozo F_1 hybrid, a result of the intensification of the production process.

Table 4

Economic efficiency of growing cocktail-type tomato hybrids (average for 2023–2025)

Indicator	Hybrid			
	Torelino F_1 (c)	Brioso F_1	Rexozo F_1	Valerioso F_1
Yield, kg/m²	23,7	25,4	27,3	24,6
Average price (2023-2025), UAH	117,2	117,5	117,2	116,8
Yield from UAH/m²	2592,2	2830,4	3080,8	2683,4
Energy costs, UAH/m²	921,5	921,5	921,5	921,5
Salary costs, UAH/m²	511,2	533,6	548,9	523,1
Costs for raw materials and supplies, UAH/m²	312,4	312,4	312,4	312,4
Packaging, logistics, marketing costs, UAH/m²	167,1	174,3	184,5	171,2
Fixed costs, UAH/m²	97,8	97,8	97,8	97,8
Other costs, UAH/m²	105,2	105,2	105,2	105,2
Total production costs, UAH/m²	1745,1	1767,5	1782,8	1757,0
Full cost, UAH/m²	2115,2	2144,8	2170,3	2131,2
Conditional net profit, UAH/m²	477,0	685,6	910,5	552,2
Net profit growth, UAH/m²	0,0	208,6	433,5	75,2
Profitability level, %	22,6	32,0	42,0	25,9

Source: compiled by the author

Despite the higher costs, the Reksozo F_1 hybrid yielded the highest level of notional net profit – 910.5 UAH/m², exceeding the control by 433.5 UAH/m². The Briozo F_1 hybrid also demonstrated high profitability (685.6 UAH/m²; +208.6 UAH/m² compared to the control), whereas the notional net profit for Valerioso F_1 was 552.2 UAH/m² (+75.2 UAH/m²).

Production profitability ranged from 22.6% to 42.0%. The highest figure was recorded for the Reksozo F_1 hybrid (42.0%), while it was 32.0% for Briozo F_1 and 25.9% for Valerioso F_1 – all exceeding the level of the control variant (22.6%).

CONCLUSIONS

Cocktail-type tomato hybrids differed significantly in the duration of developmental stages. The Brioso F_1 and Rexoso F_1 hybrids were characterized by an earlier onset of fruiting (March 26) – six days earlier than the control (Torelino F_1) – as well as a shorter "emergence-to-fruiting" period (98 days versus 103 days). Mass fruiting for these hybrids began earlier (April 2), and the fruiting period was longer at 225 days (five days longer than the control).

The hybrids under study differed significantly in biometric parameters. The highest values for key traits were observed in the Rexoso F_1 hybrid: stem length – 1,015.1 cm (+41.9 cm vs. control); number of fruits per plant – 271.1 (+24.5); number of fruits per cluster – 10.1 (+1.0); average cluster weight – 361.8 g (+68.7 g); and average fruit weight – 36.4 g (+5.0 g).

It was determined that the genotype dictates the timing of developmental stages, the duration of fruiting, and the level of yield formation. The early onset of fruiting in the Brioso F_1 and Rexoso F_1 hybrids (six days earlier than the control) facilitated the production of an early harvest and resulted in higher overall yields throughout the growing season. Based on the results of three-year studies, the Rexoso F_1 hybrid produced the highest average yield – 27.3 kg/m² – exceeding the control (23.7 kg/m²) by 3.6 kg/m² (15.2%). The Brioso F_1 hybrid achieved a yield of 25.4 kg/m² (+1.7 kg/m²; 7.2%), while Valerioso F_1 yielded 24.6 kg/m² (+0.9 kg/m²; 3.8%). The control hybrid, Torelino F_1, showed stable but lower fruit marketability (93.3%), whereas the Rexoso F_1 hybrid demonstrated a significantly higher level (96.3%; +3.0% compared to the control). The Brioso F_1 hybrid also outperformed the control in this metric (94.8%; +1.5%).

The economic efficiency of cultivation depended significantly on the genotype. The best results were obtained with the Rexoso F_1 hybrid: a revenue of 3,080.8 UAH/m², an estimated net profit of 910.5 UAH/m², and a profitability level of 42.0%. The Brioso F_1 hybrid yielded revenue

of 2,830.4 UAH/m², a profit of 685.6 UAH/m², and a profitability level of 32.0%.

Recommendations. To enhance the production and economic efficiency of growing cocktail-type tomatoes in intensive greenhouse operations, it is advisable to adopt the Rexoso F_1 hybrid, which ensures the full realization of yield potential, high product marketability, and superior economic performance. The Brioso F_1 hybrid can be recommended as a reliable early-maturing option for production diversification.

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