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ANALYSIS OF THE VARIETAL COMPOSITION OF VINEYARDS IN UKRAINE AND THE POTENTIAL FOR GROWING NEW VARIETIES

The object of current research is the varietal composition of industrial vineyards in Ukraine. One of the most problematic aspects is the assortment of table grapes, which is represented by a limited number of varieties, especially in industrial viticulture. That is why the local market is saturated with imported table grapes.

Viticulturists have been creating Ukrainian grape varieties since the middle of the last century. 150 promising varieties and hybrid forms were bred. They combine high productivity and product quality with high rates of adaptability to the «risky» growing conditions of the Northern Black Sea coast. Many years of research confirmed a high level of pathogen, drought and frost resistance, winter hardiness, as well as a high level of quality traits. The inclusion of modern Ukrainian varieties in the regional assortments, especially with the usage of intensive cultivation, will ensure the development of sustainable viticulture. Due to genetically determined pathogen resistance, a significant reduction in pesticide load is possible, which in the future will ensure the transition to adaptive, and later to organic viticulture.

The results of the analysis of the composition and structure of the assortment of grapes in Ukraine are obtained and the new varieties with a high level and stability of productivity and product quality for improving the assortment are suggested.

This provides the opportunity to increase profitability by 250–350 % for table varieties, due to high productivity, reducing pesticide load, and increasing the price of product due to the visual appearance and high taste properties. Common varieties require 9–12 pesticide treatments, the usage of additional stimulants such as gibberellins, and other elements of production intensification to obtain the marketable product. New wine varieties also show significant economic potential, as they have higher winter hardiness, pathogen resistance, and exclusive wine characteristics.

Keywords: industrial viticulture, new generation varieties, table and wine varieties, optimal varietal composition.

Received date: 11.02.2022

Accepted date: 19.04.2022

Published date: 30.04.2022

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How to cite

Belous, I., Kovalyova, I., Gerus, L., Dzhaburiya, L., Saliy, O., Skrypnyk, V., Fedorenko, M. (2022). Analysis of the varietal composition of vineyards in Ukraine and the potential for growing new varieties. *Technology Audit and Production Reserves*, 2 (3 (64)), 36–43. doi: <http://doi.org/10.15587/2706-5448.2022.256631>

1. Introduction

Despite the diversity of the grape assortment in the world, the breeding process must correspond to weather, climatic, economic, and social changes in the society. The assortment is constantly improved and replenished with varieties with exclusive taste characteristics, appealing visual appearance, and valuable and adaptive properties. The creation of new cultivars for different viticultural regions of the world is carried out in many countries with developed viticulture.

Since 1977, Embrapa Uva e Vinho (Brazil) has focused on the development of grape varieties, that represent tolerance to major grape diseases and pests, including cultivars adapted to different viticultural areas, including tropical ones [1, 2].

NARO Institute of Fruit Tree Science (Japan) has carried out many crosses of *Vitis vinifera* × *Vitis labrusca* since 2016. *Vitis vinifera* was used as a donor of such characteristics as

large berry size, high yields, dense berry pulp, and exclusive taste properties. *Vitis labrusca* was used to obtain plants with high pathogen resistance and winter hardiness, as well as the absence of berry cracking [3]. Such complex adaptive varieties demonstrate the highest economic effect from their cultivation.

Center for Viticulture and Enology, School of Agriculture and Biology, Shanghai Jiao Tong University (China) are actively using wild local species in breeding to create new disease resistant varieties since 2018. Their purposes in table grape breeding are large berry size, muscat flavor, dense berry texture, interesting color and shape of berries, early ripening capacity, and seedlessness. Due to the high level of pathogen resistance, the pesticide load will be significantly reduced and the environmental safety of the product will be ensured [4].

Atatürk Horticultural Central Research Institute (AHCRI). Considering market demand, breeders of the institute are

working on the creation of varieties with an appropriate set of characteristics. Atak 77, Pembe 77, Ismetbey, Arifbey, Samancı çekirdeksizi and Yalova Beyazıtable have been registered during the last few years. Most of these varieties are considered promising for replenishment the assortment due to fewer pesticide treatments, which is especially important in regions with high humidity [5].

Cornell University, California. In 2019 breeders from Cornell University presented a new seedless table grape variety Everest Seedless. It is characterized by large berry size, resistance to negative temperatures (up to minus 26 °C) and shows relative resistance to downy mildew and powdery mildew, as well as resistance to pests. In total, more than 70 table grape varieties are grown in California. The most common are Flame Seedless, Crimson Seedless, and Red Globe [6–8].

Thus, breeding programs in the world are mainly aimed at obtaining complex, resistant, highly adaptive table grape varieties with exclusive taste and visual appearance. The main task is the creation of highly productive and adaptive genotypes with exclusive visual appearance, taste properties, and large berry size.

Replenishment and improvement of both table and wine grape variety assortments are relevant for Ukraine too [9]. Breeding of new genotypes has been carried out since the middle of the last century. In general, the tasks of breeding programs in leading viticultural countries coincide with the main tasks of the «Resistance plus Quality» breeding program, the results of which are currently being implemented, and became the genetic basis of the new «Organic Grapes» program. Different conditions of Ukrainian viticultural regions and the diversity of new genotypes among Ukrainian grape varieties, as well as the need to unleash the potential of Ukrainian viticulture, became the basis for this work. The analysis of the available assortment revealed its shortcomings. And the analysis of promising Ukrainian table and wine cultivars allowed defining ways to increase the economic component of grape cultivation. After all, varieties and hybrid forms created by breeders from the National Scientific Center «V. Ye. Tairov Institute of Viticulture and Winemaking» (the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking», Ukraine) as a result of the gradual saturation of simple resistant hybrid forms with *Vitis vinifera* genes, that determine qualitative characteristics, successfully combine both high productivity and product quality, as well as a high level of resistance to adverse abiotic and biotic environmental factors. Such genotypes are considered by breeders as suitable for adaptive viticulture, i. e. for cultivation technology based on the usage of highly adaptive varieties that do not require significant pesticide load.

Modern industrial viticulture is a unique and economically important industry for enterprises in the southern region of Ukraine. Viticultural products are in high demand among various groups of the population both in terms of food preferences and financial capabilities.

Unlike other fruit and berry plantations, vineyards occupy from 1 to 4.5 % of the agricultural area. Literature analysis confirms that in the recent past viticulture has provided up to 17–20 % of budget revenues [10].

One of the tasks of modern viticulture is to meet the demand of the domestic market. The demand formation depends on two main factors: market capacity and purchasing power of the population. According to scientific

based standards, the annual consumption of grapes is about 8 kg per person and more [11]. According to official statistics, Ukrainians consume on average only 0.5 kg per year of this product, so the required growth potential reaches approximately 336 thousand tons, excluding wine grapes used for processing. The average yield in Ukraine has been 75 kg/ha recently. To fully provide the population with viticulture products, the area of fruiting vineyards must be doubled.

Of the total volume of Ukrainian grape export in 2018 (88.4 tons), 13.8 tons, or 15.6 %, went to European countries, 95.5 % of which were exported to Latvia. The main share of Ukrainian exported grapes in 2018 (83.3 %) went to Belarus. The largest importers of fresh grapes to Ukraine in 2018 were traditionally Turkey (76.7 %), Moldova (13.4 %), Uzbekistan (2.5 %), USA (2.2 %), Italy (2.0 %), etc. [12]. Although the price of Turkish grapes was relatively higher than the one produced in Moldova, Ukrainian consumers preferred Turkish product. The competitiveness of the latter was greater due to its higher quality and a significant amount of seedless varieties. Thus, domestic producers have an incentive to increase grape production. The domestic market is not saturated and there is significant potential to increase its supply.

Grapes are grown in many regions of Ukraine, but in the south, there are the most favorable natural and climatic conditions for its cultivation. Only by ensuring and balancing the necessary conditions and factors high efficiency and competitiveness of the viticultural industry can be achieved.

An important factor in achieving the competitiveness of table viticulture on the Ukrainian market is the cultivation of new varieties. Using new varieties and promising hybrid forms provides opportunities to extend the production period of fresh grapes and provide the population with organic product. They have the potential for spreading in industrial vineyards due to their high ecological plasticity and overall resistance to environmental stress factors, which reduces the cost of their production. New table varieties have a number of advantages over the widespread ones that is visual appearance, large cluster size, large berry size, exclusive taste properties, etc. The new wine varieties are characterized by high yields, high sugar storage capacity, exclusive aromatic and taste qualities of wine, etc. New varieties are adaptive to adverse environmental factors, thereby reducing the cost of their cultivation, in particular for pesticide treatment. Reducing the pesticide load ensures the environmental friendliness of product that meets the modern requirements of the viticultural market. The stability of the manifestation level of the main characteristics of productivity and plasticity of new generation varieties allows talking about them as an insurance fund for vineyards.

Modern breeding and natural genetic diversity of grape varieties and hybrid forms in relation to environmental stress factors is the main goal of scientific research of breeders from the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking». The diversity of adaptability traits allows developing successful strategies for selection and propagation of the most adapted to the certain conditions of cultivation grape varieties and clones, which is extremely important in the area of risky viticulture, which includes Ukraine as well.

Therefore, it is important to replenish the existing Ukrainian industrial grape assortment with varieties and hybrid forms bred in Ukraine, with different manifestation

levels and a set of characteristics of adaptability, productivity, marketability, visual appearance, and other valuable traits.

Thus, the varietal composition of industrial vineyards in Ukraine was chosen as the *object of this research*.

And the *purpose of this study* is to determine ways to increase the economic potential of industrial vineyards.

2. Research methodology

The material of this study was both widespread and new grape varieties, the analysis of their distribution in Ukraine, and the development of optimal varietal composition in vineyards for all major viticultural regions.

The following scientific methods were used in the research:

- analysis of the structure and composition of the assortment of industrial vineyards in Ukraine;
- monographic method for a detailed study of the effectiveness of the existing assortment of industrial vineyards and identifying ways to improve it;
- economic and statistical method was used for the study of the economic efficiency of growing the existing assortment in industrial vineyards to identify deficiencies in its structure and composition;
- absolute, average, and relative value methods were used to determine the level of manifestation and stability of the main economic characteristics of varieties in industrial vineyards.

3. Research results and discussion

In 2019, the analysis of the presence of modern varieties in vineyards of the main viticultural regions of Ukraine was carried out (Table 1).

It showed that these varieties occupy 5714.54 hectares, of which 3571.16 and 2143.43 hectares are lands under wine and table varieties, respectively.

The share of new varieties is 20.4 % of the total area of vineyards on average and ranges from 2.7 % (Zakarpattia region) to 52.8 % (Zaporizhzhia region) depending on the region.

According to Table 1, classic European wine varieties dominate modern Ukrainian varieties in the varietal composition of vineyards. This is due to the conservatism of winemakers and reluctance to produce wine from interspecific hybrid forms of the first generation, which could not provide the wine of the required quality. Huge breeding work was carried out, which was based on saturating crosses and strict selection by a set of certain traits. As a result, the world

grape assortment was replenished with complex interspecific hybrids with a low content of genes of resistant American species. They provide the necessary level of resistance against fungal pathogens. High quality product is ensured by the presence of 80 percent or more of the genes of *Vitis vinifera* L. In the late twentieth century in the EU it was allowed to grow such wine varieties, so cultivars with complex synthetic origin have the potential for mass distribution [13].

There are 14.5 % of modern wine varieties and they are represented primarily by varieties bred in (Table 2):

- the National Scientific Center «V. Ye. Tairov Institute of Viticulture and Winemaking» (the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking»), Tairove, Odesa Region, Ukraine: Odesskii Chernyi and Sukholimanskii Belyi;
- National Institute of Grape and Wine «Magarach» (NIGaW «Magarach»), Yalta, Ukraine: Bastardo Magarachskii, Podarok Magaracha, Pervenets Magaracha, Citronny Magaracha.

A significant portion of common wine varieties is hybrid forms of interspecific origin: Bianca (Hungary), Muskat Odesskii, Golubok, and Rubin Tairovskii (the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking») and Viorika (Moldova). 3.83 % of the area under modern varieties are occupied by Oleshkivskii and Olimpiiskii (the Lower Dnieper Scientific Research Station) (Kherson Region, Ukraine), which are hybrids with a high share of *Vitis amurensis* genes.

Among five regions, Odesa remains the leader in the production of gross viticulture and wine materials. In 2019, the total area of vineyards occupied by wine varieties in Ukraine was 25,226.71 hectares, of which 63.16 % are located in Odesa Region.

The most widespread are varieties created in the agro-climatic conditions of the Northern Black Sea region (Odesskii Chernyi, Sukholimanskii Belyi and Muskat Odesskii), which confirms their adaptability to the conditions of this area. From 2006 to 2014, several new varieties were included in the State Register of plant varieties for dissemination in Ukraine (Zagrey, Aromatny, and Iskorka). These cultivars have a complex genetic origin involving several species of *Vitis*, which provides them with complex resistance to adverse environmental factors, and a high estimated share of *Vitis vinifera*, L., which ensures the stability of quality characteristics. Wine material from these varieties has an extremely distinctive varietal aroma, which transforms into a harmonious balanced taste. However, despite their plasticity and adaptability due to a number of reasons, these varieties occupy an area of only about one hectare in Ukraine.

Table 1

The share of modern varieties in the total area of Ukrainian vineyards

Area, ha	Odesa Region	Mykolaiv Region	Kherson Region	Zakarpattia Region	Zaporizhzhia Region	Total
Total area of varieties	18150.9	5091.28	3780.02	857.78	98.48	27978.46
– wine	15934.1	4910.12	3475.35	843.14	64.0	25226.71
– table	2216.8	181.16	304.67	14.64	34.48	2751.75
Area of modern varieties	3522.63	663.67	1453.06	23.15	52.03	5714.54
– wine	1854.13	499.78	1183.70	15.55	18.00	3571.16
– table	1668.50	163.89	269.36	7.65	34.03	2143.43
% of modern cultivars of the total area of varieties	19.4	13.0	38.44	2.70	52.8	20.4
– wine	11.63	10.20	34.1	1.8	28.1	14.15
– table	75.52	90.46	88.41	52.25	98.69	77.89

Table 2

Area of new wine grape varieties in the main viticultural regions of Ukraine

No.	Variety name	Area, ha					Total
		Odesa Region	Mykolaiv Region	Kherson Region	Zakarpattia Region	Zaporizhzhia Region	
Wine varieties							
1	Odesskii Chernyi	1162.04	143.03	57.64	10.67	–	1373.38
2	Bianca	146.49	142.25	169.6	3.78	18.0	480.12
3	Pervenets Magaracha	16.63	55.99	360.42	–	–	433.04
4	Muskat Odesskii	106.04	43.76	225.07	–	–	374.87
5	Sukholimanskii Belyi	234.64	90.92	26.46	–	–	352.02
6	Podarok Magaracha	–	17.76	135.3	–	–	153.06
7	Bastardo Magarachskii	79.03	–	29.7	–	–	108.73
8	Golubok	93.97	1.42	12.0	1.1	–	108.49
9	Oleshkivskii	–	–	94.21	–	–	94.21
10	Olimpiiskii	–	–	42.5	–	–	42.50
11	Citronny Magaracha	2.34	4.63	30.8	–	–	37.77
12	Viorika	7.15	–	–	–	–	7.15
13	Rubin Tairovskii	5.8	0.02	–	–	–	5.82
Total of wine varieties		1854.13	499.78	1183.70	15.55	18.00	3571.16

In 2020, two new wine varieties were included in the State Register of plant varieties for dissemination in Ukraine (Yarylo and Odesskiy Zhemchug) with a high estimated share of *Vitis vinifera*, L. genes (over 80 %), and complex resistance to adverse biotic and abiotic environmental factors. The exclusivity and unusualness of the aroma and flavor of young wine produced from the new varieties indicate that they will be in high demand for the most demanding consumer not only in Ukraine but also around the world.

It is economically proven that the cultivation of new wine varieties bred in the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking» is quite profitable [14].

The economic efficiency of new generation varieties when planting new vineyards is based on several factors: high and stable yields, fewer chemical treatments, which are reduced due to high resistance and early-medium ripening capacity, and exclusive wine profile. According to the latter characteristic, the new varieties (white Yarylo and dark Odesskiy Zhemchug) have no analogs.

Both Ukrainian and foreign table grape varieties create a wide range of taste properties and factors of appeal for consumers, including exclusive berry shape and color. They differ in terms of ripeness and resistance to adverse environmental factors. Many of them are not included in the State Register of plant varieties for dissemination in Ukraine, but they are included in the ampelographic collection of the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking» and are used in the further breeding process. Varieties that have been studied in specialized Ukrainian institutions prove their potential throughout many years of research during the vegetation periods with different weather conditions and demonstrate not only the high level of manifestation, but also the stability of valuable traits. At the same time, there is a small number of table varieties that farmers cultivate without scientific advice, knowing neither their valuable nor adaptive characteristics but based only on marketing (large cluster and berry size) properties. In this case, only time will tell whether the farmer will make a profit or a huge

loss because the planting of one hectare of vineyards costs about 14 thousand dollars.

A large portion (47.6 %) of vineyards with table varieties in Ukraine is occupied by Moldovan varieties (Moldova, Suruchenskii Belyi, Kodryanka, Strashenskii, Dekabrskii, Muscat Yantarnyi, Sport-2, etc.), Table 3. The largest area is under the dark late-ripening interspecific hybrid Moldova (766.71 hectares), which is available for the consumer in late September and early October. High yields, relatively high resistance to major fungal diseases, good transportability, and grape marketability are the key to success in the distribution of this variety. However, its taste properties are much inferior to the classic table varieties.

A significant part (28.1 %) of vineyards is occupied by Ukrainian varieties bred in the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking» (Arcadia, Suvnir Chernyi, Flora, Original, Tair, etc.).

Arcadia variety occupies 381.12 hectares of table grape vineyards. It ripens in the open ground in the second decade of August. It is in high demand in the market due to high quality product and harmonious balanced muscat flavor. This variety has proved its potential not only throughout many years of scientific research but also by high consumer and producer demand.

5.3 % of varieties are presented by modern hybrids created in NIGaW «Magarach» (Magaracha Rannii, Shokoladnyi, Muscat Holodryha, etc.) and 2.9 % are varieties, bred by amateurs (Private individual Zagorulko V. V. (Zaporizhzhia Region, Ukraine)), VC «Vynogradna Elita» (Zaporizhzhia, Ukraine).

Only 0.38 % of vineyards are occupied by table varieties created in Odesa State Agrarian University (Ukraine), which are represented by intraspecific selection (*Vitis vinifera* L.). 10.33 % are varieties bred in Russia (Vostorg, Kesha, Nadezhda AZOS, etc.) and 1.1 % are Bulgarian varieties (Avgustin, Pleven, etc.). Most modern varieties are presented by genotypes with the complex synthetic origin and show complex resistance to adverse environmental factors.

Table 3

Area of new table grape varieties in the main viticultural regions of Ukraine

No.	Variety name	Area, ha					
		Odesa Region	Mykolaiv Region	Kherson Region	Zakarpattia Region	Zaporizhzhia Region	Total
Table varieties							
1	Moldova	577.81	101.0	87.6	0.1	0.2	766.71
2	Arcadia	295.01	7.02	67.59	0.25	11.25	381.12
3	Suvenir Chernyi	107.65	0.04	3.0	–	–	110.69
4	Muscat Yantarnyi	89.93	–	–	–	–	89.93
5	Kesha	74.78	–	13.27	–	1.0	89.05
6	Suruchenskii Belyi	77.31	–	6.6	–	–	83.91
7	Koenigin der Weingaerten	65.76	0.02	10.0	6.05	–	81.83
8	Vostorg	58.61	0.5	18.0	0.25	1.2	78.56
9	Flora	51.85	0.02	–	0.25	0.23	52.35
10	Nadezhda AZOS	0.44	51.5	–	–	–	51.94
11	Magaracha Rannii	39.17	–	–	–	–	39.17
12	Shokoladnyi	23.67	0.03	8.0	–	1.0	32.7
13	Muscat Holodryha	26.25	0.05	–	0.5	–	26.8
14	Dekabrskii	–	–	26.0	–	–	26.0
15	Original	22.11	0.05	–	–	–	22.16
16	Podarok Zaporozju	11.68	0.03	8.3	–	9.73	29.74
17	Muskat Zhemchuzhnyi	17.3	1.03	–	–	–	18.33
18	Strashenskii	3.39	1.5	10.8	–	0.03	15.72
19	Sport-2	11.0	–	–	–	0.35	11.35
20	Cardinal	11.25	–	–	–	–	11.25
21	Novyi Podarok Zaporozhye	10.75	–	–	–	–	10.75
22	Kodryanka	6.69	–	1.0	–	2.7	10.39
23	Lyubitelskii	10.36	0.03	–	–	–	10.39
24	Avgustin	9.29	–	–	–	–	9.29
25	Pleven	5.48	–	0.5	–	3.0	8.98
26	Tavriya	8.21	–	–	–	–	8.21
27	Mechta	8.13	0.03	–	–	–	8.16
28	Livija	5.2	–	1.7	–	0.29	7.19
29	Yubilei Zhuravlya	7.15	–	–	–	–	7.15
30	Tair	6.25	–	–	–	–	6.25
31	Muskat livadiyskiy	6.0	0.05	–	–	–	6.05
32	Vostok	–	0.02	6.0	–	–	6.02
33	Dunav	4.8	–	–	–	0.03	4.83
34	Yalovenskii Ustoichivyi	4.5	–	–	–	–	4.5
35	Gurzufskiy Rozovyyiy	4.15	0.02	–	–	–	4.17
36	Kishmish luchistyiy	2.24	–	–	–	–	2.24
37	Kishmish Tairovskii	–	–	–	–	2.04	2.04
38	Zagadka	1.42	0.03	–	–	–	1.45
39	Novoselovskii	1.46	–	–	–	–	1.46
40	Other modern varieties up to 1 ha (29 varieties)	1.45	0.92	1.00	0.25	0.98	4.60
Total of table varieties		1668.50	163.89	269.36	7.65	34.03	2143.43

The analysis of table grape vineyards revealed that in the Ukrainian assortment there is a shortage of early ripening varieties with large berry size (Arcadia, Novyi Podarok Zaporozhye, Kodryanka), especially dark-colored.

Ukraine has a limited number of late-ripening table varieties that are suitable for long-term winter storage. This is related to both area size and varietal composition. 27.9 % of vineyards are under dark variety Moldova, which occupies almost the entire area designated for late-ripening varieties. In addition to this Moldovan variety, the State Register of plant varieties for dissemination in Ukraine includes two new very promising dark cultivars Tair and Kometa. The share of late-ripening white varieties is only about 0.2 %. New cultivar Zagadka occupies an area of only 1.45 hectares despite the fact that it has been included in the State Register of plant varieties for dissemination in Ukraine since 2006.

The import market is tied to seedless varieties in fresh and dried form. The needs of Ukrainian consumers cannot be compensated by 12.44 hectares, or 0.61 % of modern seedless varieties, represented mainly by three pink varieties with intraspecific origin (Mechta, Kishmish luchistyi, and Kishmish tairovskii) (*Vitis vinifera* L.). Despite their genetic origin, these seedless varieties are quite promising for distribution in Ukraine [15, 16].

Insufficient production volumes of seedless varieties should not be supplemented with imported product, instead, the volume of gross production should be increased by extending the area and replenishing the State Register of plant varieties for dissemination in Ukraine with new Ukrainian seedless varieties. White cultivars «Sultanina» and «Century» are in great demand on the market of fresh grapes, which encourages Ukrainian breeders to create white adaptive seedless varieties with different ripening terms.

The reduction of costs for growing new table varieties is due to the high level of resistance to pathogens and reducing the chemical load on vineyards. It also ensures the ecological friendliness of products, as in contrast to the classic varieties of *Vitis vinifera*, L. for varieties with the complex genetic origin, the usage of chemicals is reduced by 10–20 %.

The cost of growing 1 hectare of table grape vineyards in Ukraine in 2019 on average ranged from 2.7 to 3.4 thousand dollars. The calculation of costs for growing 1 hectare of the vineyard was carried out at the price of 2019 according to the technological plans developed in the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking». Grape cultivation involves the usage of a large amount of manual labor, which is expressed in monetary terms. In Table 4 there is a comparison of the economic parameters of the growing Original variety, which has already gained some popularity, and the new generation variety Persei, which was included in the State Register of plant varieties for dissemination in Ukraine in 2020.

The main share of costs falls on harvesting, product transportation, sorting, and packaging. Reference variety Original is also an interspecific hybrid, so it does not require additional treatments with pesticides, the number of chemical treatments was limited to 5 during the vegetation period and there were no differences in plant protection between varieties.

Estimated economic efficiency showed that new varieties differ in the costs per 1 hectare. This is primarily due to the cost of harvesting. The new variety Persei has a unique

characteristic that is uniform cluster ripening and high marketability. Due to this, unlike other table varieties that require 3 harvestings, Persei is harvested only once, which reduces the cost of harvesting and transportation.

The tasting score of organoleptic characteristics of the new variety Persei (8.5 points) is slightly inferior to Original reference variety (8.6 points), so the wholesale price of the new variety is 0.07 cents lower. The non-marketable part of the yield was sold at 0.14 cents per 1 kg.

The most important and generalizing indicator of the economic efficiency of any crop, including grapes, is the level of profitability, which reflects the end result. Profitability is expressed as a percentage and shows how much profit can be obtained per 1 dollar of costs for growing products.

Table 4

Estimated economic efficiency of growing new varieties bred in the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking» (average yield during 2015–2017)

No.	Characteristics	Varieties	
		Original, reference variety	Persei
1	Yield, t/ha	24.2	18.9
	marketable product, t/ha	20.6	15.7
	non-marketable product, t/ha	3.6	3.2
2	Sales price, USD/t**, incl.	–	–
	marketable product	587.0	15000.0
	non-marketable product	4000.0	4000.0
3	Production costs per 1 ha, USD***, incl.	93834.2	56295.5
	work payment	73474.0	35932.5
	fertilizers and plant protection products	13600.0	13600.0
	materials	1400.0	1400.0
	fuel	3360.0	3360.0
	amortization	2000.0	2000.0
4	Revenue from product sales, USD/ha	364600.0	248300.0
	marketable product	350200.0	235500.0
	non-marketable product	14400.0	12800.0
5	The cost of 1 ton of product, USD	3877.4	2978.5
6	Profit from product sales, USD/ha	270765.8	192004.5
7	Profitability level, %	288.6	341.0

Notes: ** – calculated at the level of 2019 prices; *** – data obtained on the basis of costs of the Department of Selection, Genetics and Ampelography

The level of profitability of the new variety Persei is 341 %, which is 52.4 % higher than the reference variety and proves the potential for growing it in the viticultural areas of Ukraine for mass production of high quality and organic product affordable to consumers [17].

Thus, interpreting the results of this study it is possible to say that the assortment of vineyards in Ukraine is quite large and has a significant diversity of adaptive and technological characteristics. This is due to discrepancies in weather and soil conditions in different viticultural regions of the country. In addition, the main part of the vineyards is occupied by table varieties, and consumers demand diversity. The replenishment of the assortment is often uncontrolled and is carried out in response to

demands from consumers and producers. Thus, «trendy» varieties appear in the vineyards of different viticultural regions, and the adaptability of one or the other cultivar to certain growing conditions is determined empirically. The analysis of the obtained results allows speaking about the lack of table grape varieties suitable for long-term storage. There is also a shortage of early and early-middle ripening table varieties with dark berry color. Most of the used varieties require a significant pesticide load, as they originate from unstable cultivars.

The proposed improvement of regional assortments by including new grape varieties will allow developing regional conveyors of table grape varieties and, therefore, expand the period of consumption of fresh local grapes.

The proposed new varieties are complex interspecific hybrids. Many years of research prove their high pathogen resistance (at not less than the relative level), which will significantly reduce the pesticide load on vineyards and ensure the environmental safety of products. Exclusive taste and aromatic characteristics and wines from wine varieties and table grapes will allow them to compete on the market. And the stability of productivity, product quality, and resistance to adverse environmental factors will help reduce production costs and increase the economic effect of their cultivation.

New recommended varieties bred in the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking» are characterized by a wide range of mechanisms that determine resistance to biotic and abiotic stressors and consistently high yields and product quality, but the results are presented for growing conditions of Odesa Region and some viticultural regions of Ukraine. In other soil and climatic conditions, the level of manifestation of economically valuable traits may differ. A high level of pathogen resistance does not mean omitting the protection system but allows getting the desirable economic effect from their cultivation with only 4 or 5 preventive treatments.

The breeding process continues. Multistage selection of tens and hundreds of seedlings from hybrid combinations of genotypes with the largest set and level of manifestation of valuable traits is carried out. The obtained hybrid forms have a significant level of pathogen resistance (7–8 points at a 9-point scale), exclusive taste properties, and marketability of clusters and berries. They require many years of research to confirm the stability of the level of manifestation of these traits, but today it is possible to talk about the possibility of creating valuable Ukrainian grape varieties and hybrid forms.

4. Conclusions

During this research, it was revealed that the assortment of Ukrainian vineyards includes one and a half dozen modern wine grape cultivars and about 70 table grape cultivars.

It is determined that the share of modern varieties is on average 20.4 % of the total area, namely: 14.15 % and 77.9 % are occupied by wine and table varieties, respectively.

The analysis of the industrial assortment of viticultural regions proves that the largest number of vineyards with new varieties is located in Zaporizhzhia Region (52.8 %), and the smallest is in Zakarpattia Region (2.6 %).

It is determined that the share of varieties bred in the NSC «V. Ye. Tairov Institute of Viticulture and Winemaking» is almost 50 % of the total area, namely: 62 % and 28.1 % are occupied by wine and table varieties, respectively.

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