Characteristics of cultivation and development of technical grape varieties on the terraces of the Black Sea region of Odessa

Iryna Ishchenko[1*], and *Yurii* Savchuk[1, 2], and *Ibrokhim* Sapaev[3]

[1]Department of Horticulture Viticulture, Biology and Chemistry, Odesa State Agrarian University, Odesa, Ukraine
[2]Western Caspian University, Baku, AZ1001, Azerbaijan
[3]"Tashkent Institute of Irrigation and Agricultural Mechanization Engineers" National Research University, Tashkent, Uzbekistan

Abstract The article presents an analysis of long-term data obtained as a result of growing technical grape varieties under drip irrigation, such as Cabernet Sauvignon, Sangiovese Grosso and Merlot, on artificially created terraces in the coastal zone of the Black Sea. A characteristic feature of these plantations is the increased planting density according to the 1x1 m scheme, which is 10 thousand bushes per hectare. As a result of the conducted research and observations, it was established that, starting from the third year of full fruiting, excessive thickening of the crown of the bushes is observed, both as a result of powerful growth from wintering buds and as a result of the development of fattening shoots and side shoots, therefore, there is a need for pinching shoots in several stages. It has been established that with such placement it is difficult to combat the development of the main diseases of grapes, which leads to an increase in the cost of the grape protection system, however, the yield can be from 20 to 25 t/ha, while the average yield of plantings with traditional schemes is 7-12 t/ha.

1 Introduction

The grape plant, in its biological properties, is a plant of unlimited possibilities, capable of growing in any terrain, but, as nature and numerous studies confirm, it feels best on slopes, where the supply of warmth and sun is maximum [2, 5, 6, 8, 9, 10 13, etc.].

In viticulture practice, there are quite a large number of methods for developing slopes [2, 9, 10, 11], and one of them is the creation of terraced areas, which is not only a reserve for increasing the area under vineyards, but also an effective means of combating erosion processes and preventing the formation of landslides in landslide-prone areas, which significantly increases the economic and environmental value of such plantings.

Cultivation of grapes on slopes is a fairly well-studied problem; numerous studies on the study of growth, development and the influence of agricultural practices were conducted in the last quarter of the 20th century in Azerbaijan, Armenia, Dagestan, Moldova, Ukraine and

* Corresponding author: ishchenko2406@gmail.com

Western European countries. However, an analysis of the literature shows that the main issues raised were, first of all, determining the methods of developing slopes, determining the orientation of the placement of rows and studying the wide-row culture of grapes [2, 5, 8, 12]

The research conducted today in vineyards grown on slopes is aimed at assessing the photosynthetic potential and increasing the coefficient of its use [1, 3], studying management systems and the influence of nutrition zones [3, 4, 6]

However, we were unable to find information on the growth and development of grape bushes with a nutrition area of 1 m^2, so this became the main issue of our research.

The goal of this work was to create a highly productive vineyard on terraces with a dense planting scheme. Specific objectives were: establishing patterns of influence of the planting scheme on the growth and development of grape bushes of the Cabernet Sauvignon, San Giovese Grosso and Merlot varieties; determining the yield and quality of grape varieties; identifying additional cultivation techniques that ensure maximum productivity of high-quality raw materials for wine production in the existing conditions.

2 Materials and Methods

The experiments were conducted on a test plot located in the village of Liski, Limansky district, Odessa region.

The terraces were built as capital construction projects for the purpose of coastal protection. There are 6 terraces on the southern slope: 4 terraces 4 m wide and 80 m long and 2 terraces 3 m wide and the same length, the total area of the plot was 0.76 hectares. The slope is southern exposure. 4 rows are planted on the terrace.

a)

b)

Fig. 1. a) general view in the first year of vegetation, 2011; b) general view of the plantations in full fruiting, 2023.

Two rows are Cabernet Sauvignon, two rows are Sangiovese Grosso and 3 rows are Merlot. On each terrace, a clay layer was removed to a depth of 1.5 meters and filled with a soil mixture of black soil and humus in a ratio of 2:1.

Bush planting pattern: 1 x 1 m. On terraces 4 m wide, 4 rows are placed, with a width of 3 m, respectively, 3 rows, to ensure the specified bush placement pattern. Trellis - single-plane metal profile, galvanized wire, first row of wire at a height of 80 cm, above two rows of paired wire every 25-30 cm. Bush shape - two-armed Guillotine. All work on the care of the bushes and soil was carried out manually, according to the rules of agricultural technology in force for this region and the developed technological map. The general view of the terraces is shown in Figure 1.

The accounting, observations and analyses used in the research are generally accepted in viticulture [7]. The main results were analyzed using the method of analysis of variance.

3 Research results and discussion

As a result of the observations and analyzes, we found the following: that all the studied varieties on the site were characterized by a high degree of eye preservation. The development of shoots of grape bushes was characteristic of each variety, the proportion of fruit shoots by variety ranged from 88 to 99 %, depending on the variety.

Biometric indicators of grapes are the main indicators that can be used to determine the condition of grapes and potential productivity, since the grape plant, like no other, has such close correlations between the development of the aboveground and underground systems, as well as the formation and quality of the resulting crop. Among the varieties we are studying is the non-zoned introduced variety Sangiovese Grosso, which is of the greatest scientific interest from the list of selected dark berry varieties for technical use.

The analysis of the research in terms of years showed that the increase in the leaf surface area of the bush is significant as in 2020 it was 0.84 and 2.89 m^2 at the value of SSD_{05} = 0.61 m^2, in 2021 these increases were 1.45 and 0.95 m^2 at the value of SSD_{05} = 0.53 m^2, in 2022 1.65 and 0.94 m^2 at SSD_{05} of 0.61 m^2, respectively, by varieties. But this difference in 2023 in the Sangiovese Grosso variety decreased and amounted to 0.17 m^2, and in the Merlot variety also decreased to a difference of 1.52 m^2 at SSD_{05} = 0.13 m^2 (Table 1)

Table 1. Biometric parameters, bunch weight, yield per bush, quality of berries of technical grape varieties on terraces with thickened planting.

Variants	Years	Number of shoots, pcs.	Leaf area of the bush, m2	Volume of annual growth of the bush, cm^3	Number of bunches, pcs.	Weight of bunches, g.	Yield per bush, kg.	Sugar content, g/dm^3	Titratable acidity, g/dm^3
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cabernet Sauvignon - control	2020	14.6	6.04	791.74	13.9	210.8	2.93	210.0	7.5
	2021	18.3	7.61	924.69	16.6	194.3	3.23	221.5	7.2
	2022	24.5	8.53	1214.89	21.0	183.6	3.86	212.3	7.4
	2023	18.5	7.29	761.52	23.8	176.9	4.21	234.7	6.7
	average	18.9	7.36	923.21	18.8	191.4	3.55	219.6	7.2

Continuation of the table 1.

1	2	3	4	5	6	7	8	9	10
Sangiovese Grosso	2020	11.9	6.88	674.42	9.5	386.3	3.67	210.0	7.7
	2021	18.2	9.06	1011.08	17.3	312.4	5.55	215.3	7.5
	2022	21.6	10.18	1061.82	19.3	233.3	4.50	223.5	7.5
	2023	15.9	7.19	649.74	13.1	287.4	3.76	212.8	7.0
	average	16.9	8.32	849.26	14.8	304.8	4.37	215.4	7.4
Merlot	2020	19.3	8.93	1158.16	18.5	224.7	4.15	230.5	7.7
	2021	18.7	8.56	1095.73	17.5	232.7	4.07	232.6	7.6
	2022	17.7	9.47	1030.88	16.9	222.7	3.77	223.6	7.5
	2023	16.2	8.81	763.44	15.6	218.5	3.41	225.8	7.3
	average	17.9	8.94	1012.05	17.1	224.6	3.85	228.1	7.5
SSD_{05}	2020		0.61	21.00		7.62	0.35		
	2021		0.53	15.80		6.12	0.38		
	2022		0.61	5.32		1.28	0.09		
	2023		0.13	34.44		5.98	0.19		

The analysis of variance showed that the variety had the greatest influence on the change in the leaf area of the bushes, as the share of influence ranged from 85 to 96% and practically did not depend on the placement of bushes within the replication.

To obtain a more complete picture of the behavior of varietal development under a thickened planting scheme, we recorded the volume of annual growth of grape bushes. The Cabernet Sauvignon variety significantly exceeded the annual growth volume of the Sangiovese Grosso variety in 2020 and 2022, and the Merlot variety in 2020 and 2021 (Fig. 2).

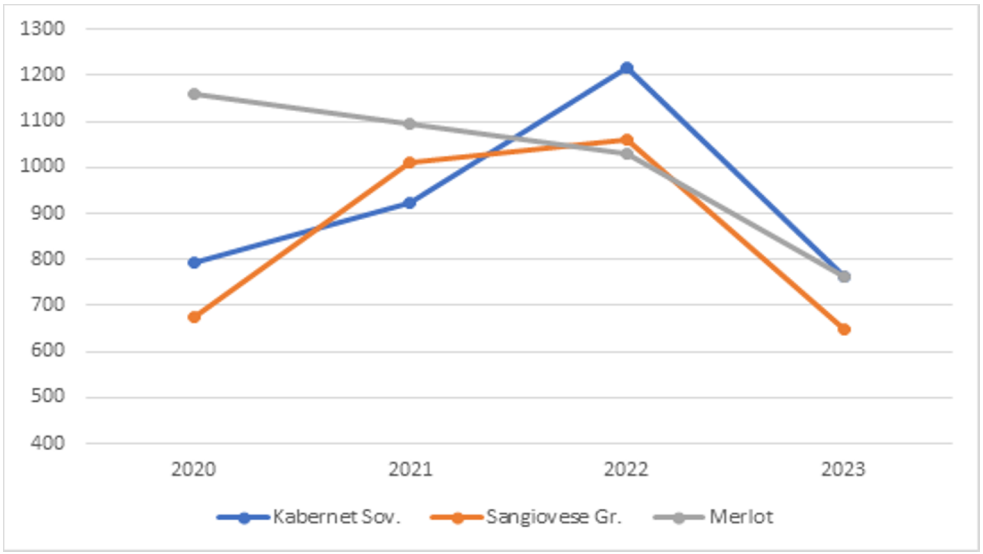

Fig. 2. Volume of annual growth of bush clones of technical grape varieties, m^3.

Thus, according to the biometric parameters of grapes, it is possible to note almost the same patterns of development of bushes of grape varieties over the years of research, but all varieties differ in leafiness and growth strength. The largest area of leaf surface is formed by the Sangiovese Grosso variety, but at the same time, the largest volume of annual growth, with thickened planting, is characterized by the Merlot variety, which has the most powerful, but less branched vines due to the formation of stepsons.

At the same time, we would like to note that the Sangiovese Grosso variety also has the largest vegetative mass and stepson-forming ability. we immediately note that a large area of the leaf surface of this variety is less damaged by the mildew pathogen, although the degree of crown thickening during lightening and ventilation is the lowest among the varieties of the experiment. The greatest mildew damage was recorded in the middle of the rows of the inner rows of the terrace. no signs of the disease were observed at all on the outer row of the terrace.

The structural component of the yield of grape plantations is the number of bunches per bush, the average weight of the bunch and the yield per bush. According to the methodology of crop accounting adopted in viticulture, we summarized the data obtained in Table 1 above.

In general, the average number of bunches per bush per variety was according to the variants: 188 bunches, 14.8 and 17.1 pieces of bunches per bush, with an average bunch weight for the years of research, respectively, by experimental variants (varieties): 191.4 g, 304.8 g and 224.6 g. Thus, the largest weight of bunches, regardless of the conditions of the year, is characteristic of the Sangiovese Grosso variety, but at the same time it has the smallest number of bunches per bush among the compared varieties.

Differences in bunch weight and the number of bunches formed on the bush formed the yield per bush, which averaged 3.55 kg per bush for Cabernet Sauvignon, 4.37 kg per bush for Sangiovese Grosso, and 3.85 kg per bush for Merlot over four years (fig. 3). This gives us reason to believe that the variety of the second variant is the most productive in the experiment, among the varieties, with a planting scheme of 1 x 1 m.

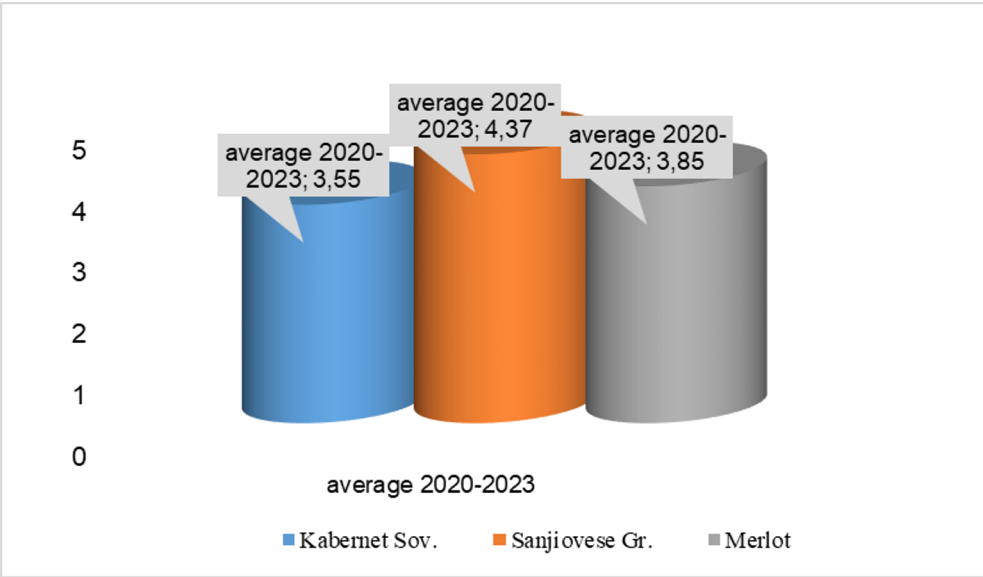

Fig. 3. Harvest from a bush of clones of technical grape varieties.

The difference between the years of the study in the yield of Sangiovese Grosso significantly exceeds the control for all four years, and for Merlot in 2020 and 2021.

The location of the vineyard on the southern slope allowed for sufficient accumulation of sugars in the berry juice at high yields, which made it possible to use them for the production of high-quality varietal wines. The sugar content ranged from 210-235 g/dm^3. The high quality and quantity of the grape harvest is explained by the productivity of the leaf surface of the grapes, which was within the optimum range of 2-2.5 m^2/kg.

4 Conclusions

Based on the conducted research, the following conclusions were made:

The development of grape bushes over the years of research on the development of biometric indicators is almost the same, but physiologically all varieties differ in foliage and growth strength. The largest leaf surface area is in the Sangiovese Grosso variety, the largest volume of annual growth is in the Merlot variety, with dense planting. On average, for 2020-2023, the mass of the bunch for experimental varieties and types was: 191.4 g, 304.8 g and 224.6 g. Based on these data, we can say that the largest mass of the bunch, regardless of the conditions of the year, is in the Sangiovese Grosso variety, which is a new variety for the conditions of Ukraine.

The average yield per hectare over four years for the Sangiovese Grosso clone was 2.1 t/ha, and for the Merlot clone - 3.0 t / ha. The average sugar content of berry juice over four years was 205-228.9 g/dm^3 with a sufficient content of titratable acids. The concentration of titratable acids in all variants and by years of research was almost the same and fluctuated within 7.2-7.7 g/dm^3. The results of the yield experiment showed that the placement of all three varieties according to a dense planting scheme allows obtaining high yields within 37.6-38.5 t/ha of high quality. However, during the vegetation periods of 2023 and 2024, which are not reflected in the article, a decrease in the value of annual growth, total leaf area and yield volume was recorded on all bushes located in the middle part of the terrace, so further research is needed to take measures to prevent a decrease in the productivity of plantings.

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