Ampelographic description, ampelometric screening and agrobiological characteristics of the Donus grape variety

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Abstract. The agrobiological and ampelographic characteristics of the Donus interspecific grape variety are given. A variety of universal use, average ripening period, the duration of the production period for 2010-2019 was 146 days with the sum of active temperatures 3297 °C. The variety is characterized by high winter hardiness. With a sum negative temperature of 586 °C and an absolute minimum of minus 25 °C, the live buds from 49% to 72.8%. Fruit shoots 90-100%, fruitfulness ratio 1.8. Yield / bush ≥ 6.9 kg with a planting pattern of 3 m $\times$ 1.5 m. It has bisexual flower, clusters of medium density, cylindro-conical with 1 -2 wings, weighing 212 g. The berry is oval, greenish-yellow, weighing about 3 g. The parameters of the berry are 14.6 $\times$ 13.4 mm. The pulp is juicy with muscat aroma. Differs in moderate sugar accumulation with moderate acidity. Resistance to mildew and oidium is high. The variety has been defined as a donor of mildew resistance. It is used for the production of juices, dry and sparkling wines, fresh consumption. The wine degustation evaluation is on average 8.5 points on a ten-point scale. The Donus is a perspective variety for commercial vitiviniculture.

1 Introduction

During 2014-2019, there is a 13% decrease in Russian wine import against the background of increase consumption, which indicates the growing demand for Russian wines in the domestic market. According to the Federal Service for the Regulation of the Alcohol Market, in 2019 Russia produced 328 million liters of still wines and 132 million liters of sparkling wines, which is 8% and 6% more than in 2018. Production in 2019 increased for the first time in the last 4 years.

It is necessary to use all available opportunities to improve the taste and dietary qualities of wine by reducing the pesticide load of grape plantations and improving production technology. This indicates the need to revise the varietal policy in viticulture, it is necessary to include in planting grape varieties that meet modern technologies using climatic indices of plant adaptation to climatic growing conditions, including taking into account the

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duration of the frost-free period [1-4]. The northern zone of industrial viticulture in Russia makes special demands on the degree of adaptation of varieties in connection with a shorter growing season, significant winter frosts and provocative thaws that are destructive for grapes, followed by a sharp drop in temperature. Temperature anomalies not only significantly reduce the productivity of grape plantations, but sometimes lead to the complete death of the bushes. Recently, there has been an increase in the frequency of stressful situations due to climate change. In this regard, work on the study of the reaction of varieties in difficult climatic conditions and the accumulation of long-term data on the behavior of varieties in specific regions are relevant [2, 5-6].

Insufficiently high frost resistance of varieties is one of the main limiting factors for expanding the area of industrial cultivation of grapes. Improving the assortment on the basis of winter hardiness is an urgent and practically significant task for the northern regions of grape growing. Due to the instability of weather conditions, work on the creation of economically more profitable varieties with genetically determined resistance to low winter temperatures, pests and diseases are very relevant and are being carried out on different scales in almost all specialized institutes of the world. The introduction into production of new highly productive, winter-hardy varieties is of decisive importance in increasing the profitability of grape plantations [7-8].

Traditionally, most of the European grape varieties are cultivated in the world for wine production, which have proven themselves to be of high quality of finished products [9-10]. But work to improve the grape assortment by including resistant varieties of interspecific origin is being carried out in many countries with a developed viticulture industry [7, 11-12]. In Russia, in the northern zone of industrial viticulture, the level of frost resistance of the variety is one of the main factors that determine the prospects for its use in production. Therefore, the topic of breeding frost-resistant, high-quality technical varieties meets the requirements of practical significance, novelty and relevance. The domestic grape assortment should contain new varieties that have group resistance to unfavorable environmental conditions, increased resistance to major fungal diseases and a sufficiently high quality of wine products produced from them.

To study the degree of resistance of grape varieties to fungal diseases, it is of interest to work on the correlation

dependence of the morphological traits of leaves and the degree of mildew damage to the leaf apparatus [13]. To calculate the potential yield of a variety, the study of agrobiological indicators remains relevant: the mass of bunch, the coefficient of fruiting, which depend primarily on the genetic potential of the variety [14]. For a complete study of the variety, a combined approach should be used, including phenotypic characteristics (ampelographic description and oenological characteristics) and molecular analysis [15].

Thus, the creation and complete, detailed ampelographic and agrobiological study of grape varieties is relevant and necessary for the admission of a variety to cultivation in a particular region.

2 Methodology

The study of agrobiological and phenotypic indicators of the Donus grape variety was carried out on the territory of the Experimental field ARRIV&W - a branch of the "Federal Rostov Agricultural Research Centre", Novocherkassk, Rostov Region, Russia. Donus variety grafted on Berlandieri × RipariaKober 5BB stock. The study was carried out according to generally accepted methods in viticulture.

Phenological observations, determination of indicators of the load of bushes with eyes, shoots and crops, fertility of bushes, weight accounting of the harvest, study of the strength

of growth and the degree of ripening of annual shoots, the ripening time of berries were carried out according to the method of M.A. Lazarevsky“Study of grape varieties”, 1963.

Evaluation of winter hardiness and frost resistance was carried out according to the number of blossoming buds that developed full-fledged shoots on the bushes, the productivity and yield of the bushes.

Evaluation of the quality of the crop is carried out by determining the content of sugars and acids in the juice of berries as they ripen. The sugar content of the juice of berries was determined by a refractometric method, the acidity was titrated with 0.1 N NaOHsolution against bromothymol blue.

Description of the variety was carried out according to the international methodology, finalized by the Federal State Budgetary Institution "State Variety Commission", the description methodology developed by M. Lazarevsky.

Ampelometric screening was carried out using the program: Analyzer of morphology and structure of plants "SIAMS Mesoplant" [25].

The wine is prepared in the laboratory of the Institute's wine-making technology. After self-clarification and removal of wines from the sediment, their analytical and organoleptic studies were carried out. The technological assessment was carried out in accordance with the current regulatory instructions, the sugar content of the wort and the content of titratable acids were determined according to the State Standard.

The analysis of the chemical composition of wine was carried out using methods of analysis generally accepted in winemaking.

The organoleptic assessment was carried out by the institute's tasting committee on a 10-point scale.

3 Research results

The Donus variety (patent No. 10257 dated 06/05/2019) was bred to All-Russian Research Ya.I. Potapenko Institute of Viticulturel and Winemaking - Branch of Federal State Budget Scientific Institution "Federal Rostov Agricultural Research Centre as a result of crossing the SV 12-375 and Druzhba varieties.Included in the State Register of Breeding Achievements Permitted for Use in 2020.

Refers to varieties of universal use, the average ripening period, the duration of the production period varies from year to year: from 131 to 164 days, the average for the 10 studied years is 146 days, the sum of active temperatures until the full ripeness of the berries was 3297⁰C. In Novocherkassk, it ripens in mid or late September (table 1).

Table 1.The stages of the vegetation grapes variety Donusin 2010-2019

Years	The stages of the vegetation				Production period	
	beginning of bud opening	beginning of flowering	beginning of berry ripening	full maturity of berries	number of days	totalactive temperatures, °C
2019	24.04	24.05	25.07	5.09	132	2934
2018	23.04	25.05	31.07	1.10	161	3738
2017	28.04	9.06	30.07	10.10	165	3525
2016	15.04	4.06	23.07	27.09	165	3463
2015	3.05	4.06	22.07	12.09	134	3063
2014	25.04	30.05	18.07	3.10	161	3528
2013	28.04	26.05	18.07	3.09	128	3049
2012	23.04	19.05	6.07	1.09	131	3128
2011	4.05	6.06	27.07	28.09	147	3281
2010	1.05	4.06	3.08	14.09	136	3263
average	26.04	31.05	22.07	19.09	146	3297

Young shoot. The crown of a young shoot is open, bronze with a slight tomentose pubescence. The first leaf above is shiny, bronze in color, the main veins are green, below the leaf is green with a slight tomentose pubescence. The second leaf from above is green with a bronze tint, from below - green with a weak tomentose pubescence. The edges of the leaves have an anthocyanin coloration (brown-red clear outline). The petiole of a young leaf is green with wine-red stripes (Figure 1). The young shoot is erect, the color of the dorsal side of the internode is green, the ventral side is green with red stripes, the nodes on the dorsal side are wine-red, on the ventral side they are green, the number of tendrils on the shoot is more than three average lengths.

The leaves are pentagonal, of medium size: the area of the leaf blade is on average 195, 9 cm², the perimeter of the leaf is on average 126.35 cm; leaves are green, moderately dissected, three-lobed, less often five-lobed, the upper side of the leaf is smooth or slightly reticulate-wrinkled, underneath is sparse bristly pubescence. The upper notch is open, lyre-shaped with parallel or vaulted sides, the depth of the notches is medium or shallow. The lower notches are small, open in the form of a reentrant angle. The petiolate notch is usually open, vaulted or lyre-shaped with a rounded bottom. The denticles at the ends of the lobes are large, narrowly triangular, with a concave-sided apex extended at the tip. The denticles along the edge of the leaf are large, sharp, saw-shaped with concave or straight sides.

The petiole is wine-red, 8.54 cm long and shorter than the midrib (figure 1). Autumn color of leaves is yellow.

Fig. 1. Leaf of the Donus variety

For additions to the description of the leaves of the Donus variety on the distinctness, uniformity and stability, measurements of 15 leaves were made using the computer program Analyzer of morphology and structure of plants "SIAMS Mesoplant" for 33 parameters, the average data of measurements are presented in Table 2.

Table 2. Parameters of the leaves of the Donus variety

No.	Measurement parameter	Unit measurement	Maximum	Minimum	Average
1.	Leaf surface area, S	cm ²	147.30	240.60	195.90
2.	The perimeter of the sheet plate, P	cm	103.10	154.90	126.35
3.	Sheet plate length, N	cm	17.23	21.70	19.26
4.	Sheet plate width, W	cm	15.84	20.10	17.90
5.	Petiole length, L0	cm	6.80	10.85	8.54
6.	Midvein, L	cm	12.60	15.84	13.90
7.	Upper right lateral vein, Lr1	cm	8.15	14.38	12.20
8.	Lower right lateral vein, Lr2	cm	7.60	11.20	9.30
9.	Upper left lateral vein, Ll1	cm	11.48	13.07	12.30
10.	Lower left lateral vein, Ll2	cm	7.40	10.08	9.00
11.	Angle alpha, $\alpha^\wedge$	degree	33.40	57.10	43.60
12.	Betta angle, $\beta^\wedge$	degree	34.90	58.50	48.45
13.	Zetta angle, $c^\wedge$	degree	35.10	75.10	49.30
14.	Angle gamma, $t^\wedge$	degree	41.10	84.50	61.42
15.	Delta angle, $d^\wedge$	degree	102.10	139.50	119.95
16.	Upper tooth length, ld1	cm	0.63	1.90	1.35
17.	Upper tooth width, ad1	cm	0.68	1.63	1.076
18.	Length of the right extreme tooth, ldr2	cm	1.0	2.19	1.66
19.	Right extreme tooth width, adr2	cm	0.86	1.80	1.18
20.	Length of the left extreme tooth, ld12	cm	1.06	1.87	1.50
21.	Left extreme tooth width, ad12	cm	0.94	1.57	1.21
22.	Length of the right lower tooth, ldr4	cm	0.85	1.58	1.14
23.	Width of the right lower tooth, adr4	cm	0.78	1.68	1.21
24.	Length of the lower left tooth, ld14	cm	0.75	1.40	1.05
25.	Left lower tooth width, ad14	cm	1.02	1.51	1.23
26.	Distance between lower blades, d	cm	1.37	7.23	3.61
27.	Depth of petiole notch, h0	cm	2.87	5.45	4.27
28.	Top right pre-coil distance, hr1	cm	4.30	7.61	6.20
29.	Left upper pre-coil distance, hl1	cm	3.81	7.34	5.97
30.	Right bottom pre-coil distance, hr2	cm	4.28	8.90	6.80
31.	Left bottom pre-coil distance, hl2	cm	4.54	8.34	6.90
32.	Lowest right vein, Lr3	cm	2.68	6.0	3.50
33.	The lowest left vein, Ll3	cm	2.20	5.60	3.40

The flower is bisexual. There are five stamens. The stamenfilaments are longer than the pistil. Bunches of medium density, cylindrol-conical with 1-2 wings, weighing 212 g. The stalk is long, green, sometimes lignified, the stem is green, herbaceous (figure 2).

The berry is oval, greenish-yellow with an intense pruina, weighing about 3 g, the parameters of the berry are $14/6 \times 13.4$ mm (figure 3).

Fig. 2. Ampelographic snapshot of Donus

Fig. 3. Donus grape berries

The pulp is juicy with a muscat aroma. Differs in moderate sugar accumulation - up to 240 g/dm^3 , with moderate acidity: $3.6\text{-}7.0 \text{ g/dm}^3$ (Table 3).

Bushes are vigorous. The internodes of an annual ripe shoot are light brown, the nodes are brown. The variety is characterized by high winter hardiness, the percentage of budding is from 49 to 100%. Fruiting shoots are 90-100%, the fruitfulness ratio 1.8. On a single-plane trellis, with a planting pattern of $3 \times 1, 5 \text{ m.}$. The yield from 1 bush 6.9 kg and more. The recommended load is 20-25 buds per bush, pruning of fruiting vines is short 2-3 buds (table 3).

Table 3. Commercially valuable characteristics of the technical grape variety Donus, 2010-2019.

Years	Normal shoots per bush, pcs.	Live buds, %	Fruit-bearing shoots, %	Fruitfulness ratio	Average bunch weight, g	Shoot productivity, g	Bush yield, kg	Estimated yield, c/ha
2019	20	100	94.0	1.7	250	425	8.5	189
2018	25	91.2	95.0	1.6	164	262	6.5	144
2017	29	89.0	98.0	1.5	190	285	8.3	184
2016	19	72.8	96.5	1.6	129	206	3.9	87
2015	13	49.0	42.1	0.5	208	104	1.3	29
2014	38	83.2	79.0	1.1	137	151	5.7	127
2013	48	83.1	82.2	1.4	150	210	10.1	224
2012	23	68.2	90.1	1.5	304	455	10.3	229
2011	18	78.3	93.0	1.6	342	547	9.8	218
2010	23	92.1	96.0	1.7	246	418	4.4	98
average	26	80.7	86.5	1.4	212	306	6.9	153

The Donus variety can withstand frost up to 28°C without covering the bushes. Ripening of shoots and regeneration capacity are good. After the winter of 2005-2006 at a minimum air temperature of minus 28°C , Donus recovered with shoots from old wood, the bush trunk and vine arms had minor damage to the bast. In 2012, with a sum of negative temperatures of 586°C and an absolute minimum temperature of minus 24°C , 68,2% of

living buds were noted, in 2015 with an absolute minimum of temperatures of minus 25 °C and sharp fluctuations in spring temperatures – 49,0% of living buds.

In the North Caucasus region of Russia, the most dangerous fungal diseases of grapes are: mildew (*Plasmopara viticola* Berl. Et de Toni), powdery mildew (*Uncinula necator* Burril.), Gray rot (*Botrytis cinerea* Pers.). The maximum infestation of the Donus variety with mildew is 2,5points, with mildew and gray rot 2,0 points (table 4).

Table 4. Resistance to adverse environmental influences, point

Years	Sustainabilityindicators					Winterhardiness
	resistance to fungal diseases			indicators of negative		
	Mildew	Oidium	Gray	min,	sum	
2010	0	0	0	22.0	418	5.0
2011	1.0	0.5	0	20.5	450	4.0
2012	0	0	0	24.0	586	4.0
2013	2.0	2.0	2.0	18.5	293	4.0
2014	1.0	1.0	0	24.6	325	4.0
2015	2.5	2.0	0	24.5	284	3.0
2016	2.0	2.0	0	20.5	200	4.0
2017	1.5	1.5	0	18.9	389	5.0
2018	1.0	1.0	0	13.6	214	5.0
2019	1.0	2.0	0	11.5	197	5.0
average	1.2	1.2	0.2	19.9	366	4.3
max	2.5	2.0	2.0	24.6	586	3.0

The variety was determined as a donor of mildew resistance, the maximum damage to the leaves was noted at 2.5 points, and the average damage was 1.2 points. The most epiphytotic year was 2015. This year, the analysis of the hybrid offspring of four crosses: Donus × Muscat Golodrigi (resistant × resistant), Donus × Mugofir (resistant × tolerant), Donus × Efremovskii and Pukhliakovskii belyi × Donus (resistant × susceptible) showed a high percentage of tolerant seedlings (from 23 to 68 %) and 8% resistant seedlings in the population resistant × resistant. Higher results in the inheritance of mildew resistance by hybrid offspring are shown when using the Donus variety as the maternal form (figure 4, 5).

Fig. 4 .Resistance to mildew of parental forms

Fig. 5.Distribution of hybrid offspring by points of resistance to mildew, %.

Donus is characterized by a high juice yield - 79% on average, which is very valuable for winemaking (table 4).

Table 4. Mechanical composition of bunches and berries of the technical grape variety Donus, 2010-2019

Years	Date of analysis	Average weigh, g		Stem, %	Skin with pulp, %	Seeds, %	Juice yield, %	Mass concentration, g/dm ³	
		bunch	berry					sugar	acid
2019	17.09	250	3.2	2.3	13.2	5.2	79.3	243	3,6
2018	01.10	184	2.5	2.7	11.0	5.1	81.2	197	4,2
2017	10.10	193	2.2	4.2	22.0	2.5	71.3	159	4,9
2016	29.09	230	3.2	1.9	16.9	4.8	76.4	216	6,1
2015	26.08	208	3.4	1.6	16.8	3.5	78.1	157	6,7
2014	30.09	216	2.4	3.2	15.5	5.1	88.2	159	4,7
2013	03.09	150	2.0	2.9	9.3	5.1	82.7	179	4,7
2012	28.08	304	3.0	2.5	13.2	4.1	80.2	149	5,6
2011	16.09	342	3.4	2.2	19.6	2.9	75.3	161	6,9
2010	14.09	246	3.2	3.0	15.4	4.6	77.0	159	4,8
average	20.09	232	2.8	2.6	15.3	4.3	79.0	178	5,2

The variety is used for the production of juices, dry and sparkling wines, fresh consumption. The end result of studying a variety is its technological evaluation. The obtained wine samples from the Donus grape variety had a volume fraction of ethyl alcohol from 9,5 to 11,8%, titratable acids 4,3 – 7,6 g/dm³, volatile acids not higher than 0,64 g/dm³, the level of 17,4 – 20,8 g/dm³, which corresponds to the requirements of regulations (table 7).

Table 7. Chemical and organoleptic characteristics of wine from the Donus grape variety, 2011-2019 (type of wine - dry white)

Years	Chemical indicators of wine
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	alcohol % vol. l	titratable acids,g/dm ³	volatile acids, g/dm ³	extract, g/dm ³	SO ₂ ,g/dm ³	
					free	total
2019	10.8	7.6	0.54	20.8	19.6	102.6
2018	11.8	5.5	0.48	19.7	16.2	152.9
2017	9.5	4.5	0.44	17.5	14.8	126.8
2016	11.2	5.8	0.64	18.9	11.8	104.9
2015	10.4	4.3	0.64	19.4	15.3	105.6
2014	11.7	4.7	0.42	18.6	14.8	186.4
2013	11.2	4.5	0.48	17.9	12.8	98.6
2012	10.1	7.6	0.64	17.8	16,8	168.8
2011	11.3	6.4	0.54	18.8	17.6	128.8
2010	11.8	4.9	0.57	17.4	18.6	116.9
average	10.9	5.6	0.53	18.6	15.8	129.2

Organoleptic evaluation is the main indicator of the quality of a wine. Wine from the Donus variety have an elegant appearance, pale straw color, delicate, graceful aroma with delicate nutmeg notesand a light, harmonious taste. The wine degustation evaluation in average 8.5 points on a ten-point rating scale.

4 Conclusion

Donus is a promising new variety of interspecific origin and is recommended for cultivation in the 6th region of industrial viticulture in Russia. High resistance to fungal diseases allows cultivating the variety with a minimum fungicidal load in the form of 2-3 preventive treatments, and the high frost-winter hardiness of the variety makes it possible to recommend the variety for cultivation in a non-covering crop even in the area of covering industrial viticulture.

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