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Creation of New Competitive Grape Varieties with Different Ripening Times and With High Commercial and Gustatory Qualities Bred by the Kazakh Research Institute of Fruit Growing and Viticulture

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The aim of this work is to create new competitive grape varieties with high quality crops for the purpose of diversification of the grapes assortment in Kazakhstan. The study found that the most valuable grape varieties with regard to the complex of economically-valuable traits suitable for the submission to the primary variety testing are the hybrid forms of grapes PI-7/21, PI-9/2, PI-10/3, P I-10/31, P I-12/13, DIV-6/23, D IX-27/60, DVII-3/61,KV-2/35, KIII-3/39. Based on the results of the research carried out in 2012-2014, two new grape varieties were submitted to the State variety testing: Akzhayyk (K I-2/9), received by crossing between varieties Nimrang E Cardinal, and Meiram-55 (DVII-8/45), received by crossing between varieties Fioletovyi Rannii E Ilijskii.

Key words: Grapes, variety, hybrid nursery, breeding, gene pool, introduction, winter hardiness, productivity, the quality of berries, the degree of the ripening of shoots.

According to the modern requirements, new varieties should possess a wide range of valuable characteristics and qualities, such as winter hardiness, disease resistance, good bunch appearance, high productivity, technological effectiveness, etc. Creation of such varieties is the urgent task of the grapes selection program in the CIS countries and in Kazakhstan in particular.

The need to improve and update the grapes assortment is dictated by the requirements which are currently imposed on the quantity and quality of crops. A correctly selected variety combined with the advanced level of cultivation technology reduces the cost of growing and harvesting. High insect pest and disease resistance of varieties reduces the number of treatments, pesticide consumption and pesticide load on the product. Using varieties with high adaptation level also reduces the risk of crop failure due to adverse weather conditions. All of this significantly increases the level of profitability of viticulture, improves the economic performance of enterprises and the environmental situation in the wine-growing regions.

Due to the quarantine aimed at the prevention of the distribution of the grape gall louse, the import of varieties from other wine-growing regions is forbidden, and virtually the only source of the replenishment of the gene pool of

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the grapes is selection.

Viticulture is one of the most knowledge-intensive agricultural industries, which successfully combines the centuries-old experience and the latest developments in the field of strain renovation, environmental science, microzonation and other directions of forming highly productive and stable farming ecosystems. The modern viticulture is characterized by the rapid progress in the sphere of improving the assortment. The required property of new varieties is high productivity. This task is solved by increasing yielding capacity and improving the quality of grapes through selection [Nikulushina, 2009].

The existing varieties of grapes need to be sheltered for the winter and to be opened in the spring; there is also a number of other labor-intensive agrotechnical measures. Therefore the creation of new complex resistant varieties is a decisive factor in improving and maintaining the quality of grapes and the yielding capacity. In the process of evolution the specialization of grape varieties took place, i.e. their adaptation to the strictly limited environmental conditions.

Despite the favorable soil and climatic conditions of the southern regions of Kazakhstan, which make it possible to cultivate grapes with different ripening times, the productivity remains low, and the grapes assortment is rather poor. It is necessary to supplement the grapes assortment with new competitive varieties, which will make it possible to significantly increase the productivity and the efficiency of grapes cultivation, to provide the population with fresh grapes and products of their processing.

Along with other measures, the correct selection of varieties for different zones of industrial viticulture plays a crucial role in increasing the productivity of grapes and improving the quality of products. According to the modern requirements, new varieties should possess a wide range of valuable characteristics and qualities, such as winter hardiness, disease resistance, good bunch appearance, high productivity, technological effectiveness, etc. Creation of such varieties is the urgent task of the grapes selection program in the CIS countries and in Kazakhstan in particular.

The focused breeding work in a number of research institutes (the National Institute for Viticulture and Winemaking "Magarach", the All-Russian Research Institute for Viticulture and Wine Making, the Ukrainian Research Institute for Viticulture and Wine Making, the Kuban State Agricultural University, the Armenian Research Institute for Viticulture, Wine Making and Fruit Production, etc.) resulted in the development of a number of varieties which meet these requirements.

The leading institution in the field of the grapes selection in Russia is the Ya.I. Potapenko All-Russian Research Institute for Viticulture and Wine Making, where two parallel lines of selection have been developed – intervarietal and interspecific hybridization. The developed grape varieties Seyanets Malengra, Black Sweet, Russian Concord and a number of others provided the basis for the Northern viticulture and were used in the further breeding work, and the frost-resistant varieties Arctic and Bujtur are used as rootstocks. Selection of resistant grape varieties on the basis of interspecific hybridization was continued in the Central genetic laboratory [Potapenko, 1972]. At the same time extensive hybrid gene pool was created – about 30 thousand seedlings received by crossing Vitis silvestris with the interspecific forms of Vitis vinifera [[Abaryants and Agahanov, 2004; Kostrikin, 2001].

Development of new varieties, combining high productivity with high quality of crop and resistance to biotic and abiotic stresses, remains the main task of the selection of grapes. At the same time the breeders have recently paid more attention to the development of plant varieties with valuable biomedical and medicinal properties. On the basis of the analysis of the varieties bred by V.A. Nosulchak, it was noted that the breeder, who used tens of thousands of hybrid seedlings received by several hundreds of crossing combinations, managed to develop varieties, which are considerably superior to the Madeleine Angevine in all the parameters, which is largely determined by the role of the paternal varieties [Nosulchak, 2012].

According to the reports from S.V. Shcherbakov, A.V. Dergunov and other scientists from the Anapa Zonal Experimental Station of Viticulture and Wine Making, new wine grape varieties Gordyi, Pluton, Muzhestvennii were

developed. New varieties are characterized by high productivity and high crop quality, which makes them competitive in the modern market [Shcherbakov, Dergunov, Larkina, Nikulushkina and Lopin, 2013].

The Volga region offers all the key factors required for the successful grape cultivation. First of all, it is due to the sufficiently warm climate, long duration of the frost-free period (135-160 days), intensive insolation. The snow cover is formed mainly in November, low relative humidity prevents the development of diseases, such as mildew and rot. The outbreak of these diseases is possible only in some wet years, under the condition of unfavorable agricultural background (for example, in the case of thick planting). According to the results of the long-term study of the introduced grape varieties the following varieties can be recommended for cultivation in the Samara Region: Muscat Letnii, Agat Donskoi, Kodryanka and Rusbol [Vechernev, 2012; Vechernev, 2011].

To evaluate seedlings and new varieties according to the method of P.N. Nedov, artificial infectious background was created. Using wild varieties of grapes in the process of breeding required the evaluation of the quality of the crop of the new varieties. L.F. Meleshko and I.A. Kostrikin [Kostrikin, Meleshko, Chebanenko et al., 2001] found that the presence of diglucoside, with which many researchers associate the poor quality of products of processing of grapes of interspecific hybrids, is characteristic not only for the Amur and American varieties, but also for a large group of varieties of Vitis viniferf and forms of Vitis silvestris, and therefore cannot be a taxometric characteristic.

The North-Caucasian Zonal Research and Development Institute of Horticulture, Viticulture and Wine Making also carries out extensive selection work. Together with the Anapa Zonal Experimental Station of Viticulture and Wine Making, the breeders of the Institute have developed the varieties of Avgalia, Kavkazskii Rannii, Granatovii, Barhatnii, Marinka, Nadezhda AZOS, which were included in the State Register of selection achievements of the Russian Federation. At the Derbent Experimental Station of Viticulture the following released grape varieties have been created: Dolchatii, Muscat Derbentskii, Muscat Transportabelnii, Slava Derbenta [Hmyrov, Shcherbakov and Nikulushkina, 2010; Feyzullayev, Kazahmedov and Kaziev, 2013].

At the National Institute for Viticulture and Wine Making "Magarach" in Ukraine, based on the research results, a group of own-rooted varieties has been developed: Antei Magarachskii, Bianca, Viorica, Zala Dende, Laktiedi Mezesti, Mizia, Moldova, Podarok Magaracha, Shambursen, Magaraci, Jubileinii Magaracha, Yalovenskii Ustoichivii [Kostik and Yurchenko, 2005]. Four varieties (Podarok Krymu, Sersial Magarachskii, Muscat Yalty, Muscat Magaracha) were developed by clonal breeding, the variety of Avrora Magaracha was bred by mutagenesis, the variety of Polivitis Magaracha was bred by polyploidy, [Volynkin, 2003; Kostrikin, Majstrenko et al., 2010].

At the Kazakh Research Institute of Fruit Growing and Viticulture with the purpose of extending the assortment of table grape varieties the long-term breeding activities have been carried out to create new large-bunched table varieties with different ripening times, which would be competitive in the domestic and international market. As a result of the breeding activities extensive hybrid gene pool of table grapes have been created, from which, using the "step-by-step" method, the best hybrids are selected, the potential varieties [Kazybaeva, 2008; Kazybaeva and Suyunbaeva, 2011].

The objectives of the research are: the selection of highly adaptive, complex-resistant hybrids of grapes for the breeding nursery, the development of new table and wine large-bunched grape varieties with different ripening times, highly productive, with good commercial qualities of berries and good transportability, the breeding and and submission of the new varieties to the State variety testing followed by the regionalization in the wine-growing regions of Kazakhstan.

Materials and methods of research

Breeding of new grape varieties was carried out at the experimental farm of LLP Kazakh Research Institute of Fruit Growing and Viticulture and at JSC Kaplanbek. The experimental plot of JSC Kaplanbek is located in the Saryagash district in the southern

environmental and climatic zone of the South-Kazakhstan region, which is characterized by strong continentality, air dryness and abundance of warm days. The soil is represented by gray soils, the humus content in the top soil (0-30 cm) is 1.35%, the labile phosphorus content is 15.0 mg/kg, the nitrate nitrogen content is 16.8 mg/kg, the exchange potassium content is 208.0 mg/kg. The planting layout was 3 x 2 m. The experimental plot of LLP Kazakh Research Institute of Fruit Growing and Viticulture is located in the Talgar district of the Almaty region. The soil is represented by black earth soils, the humus content in the top soil (0-30 cm) is 5.5%, the labile phosphorus content is 2.5 mg/kg, the nitrate nitrogen content is 8.5 mg/kg, the exchange potassium content is 28.6 mg/kg [Chulturov, 1964]. The planting layout was 3 x 1.5 m.

The objects of the study were the hybrid nursery and the breeding nursery.

The study was carried out according to the generally accepted methodology "The study of grape varieties" [Lazarevsky, 1963], "Methodological guidelines on breeding of grapes"("Methodological guidelines on breeding of grapes", 1974). The mathematical processing of the data was carried out according to the "Methodology of the field experiment" [Dospehov, 1985].

RESULTS AND DISCUSSION

Winter hardiness was determined and the phenological assessment of budbreak in the hybrid forms of grapes was carried out. Compared to 2013, the budbreak occurred a bit later in 2012, but earlier than in 2014.

The earliest budbreak (14 April) was observed in the hybrids resulting from the crossing combinations Olimpiada × Muromets. The budbreak occurred 2 days later (16 April) in the hybrids resulting from the crossing combinations Vierul 59 E Kishmish Kazakhstanskii, Vierul 59 × Olimpiada, Pamyati Negrulya × Muromets, Jubilei Moldavii × Krymskaya Zhemchuzhina. The latest budbreak was observed in the hybrids resulting from the crossing combinations Alma-Ata × Kishmish Moldavskii and Vierul 59 × Medeo (21 April). In many hybrid plants the budbreak was observed on the 17th of April (Table 1).

In 2013 the earliest budbreak (8-9 April) was observed in hybrids resulting from the crossing combinations Olympiada × Muromets and Vierul 59 x Medeo. In the second ten-day period of April (10-14 April) the budbreak was observed in plants resulting from the following crossing combinations: Moldova × Krymskaya Zhemchuzhina, Jubilei Moldavii × Medeo, Kyzyl Tan × Jubilei Moldavii, Jubilei Moldavii ×

Table 1. Phenological observations of hybrid plants. Hybrid nursery (2012-2014)

Crossing combination	Date of budbreak			
	2012	2013	2014	Average
Moldova × Kishmish Kazakhstanskii	18.04	12.04	27.04	19.04
Alma-Ata × Kishmish Moldavskii	21.04	14.04	29.04	21.04
Vierul59 × Kishmish Kazakhstanskii	16.04	12.04	27.04	18.04
Jubilei Moldavii × Medeo	19.04	13.04	27.04	20.04
Jubilei Moldavii × Krymskaya Zhemchuzhina	16.04	10.04	24.04	17.04
Olympiada x Muromets	14.04	8.04	24.04	15.04
Moldova × Kyzyl Tan	19.04	12.04	26.04	15.04
Kyzyl Tan × Jubilei Moldavii	18.04	13.04	24.04	18.04
Moldova × Krymskaya Zhemchuzhina	17.04	10.04	26.04	18.04
Vierul59 × Medeo	21.04	9.04	27.04	19.04
Moldova × Muromets	17.04	12.04	28.04	19.04
Moldova × IX-25/67	17.04	12.04	28.04	19.04
IX-25/67 × Krymskaya Zhemchuzhina	14.04	12.04	28.04	18.04
Vierul59 × Olimpiada	16.04	12.04	27.04	18.04
Pamyati Negrulya × Muromets	16.04	13.04	29.04	19.04
Vierul59 × Muscat	17.04	12.04	27.04	19.04

Table 2. Overwintering characteristics of hybrid plants. Hybrid nursery (2012-2014)

Crossing combination	The total number of buds, pcs/vine				Living buds, pcs/vine				The degree of overwintering, %			
	2012	2013	2014	Average	2012	2013	2014	Average	2012	2013	2014	Average
Moldova × Kishmish Kazakhstanskii	21.4	173.2	142.0	112.2	15.5	118.8	98.0	77.4	72.4	68.5	69.0	69.9
Alma-Ata × Kishmish Moldavskii	32.5	137.5	80.2	83.4	17	82.5	37.1	45.5	52.3	60.0	46.2	52.8
Vierul 59 × Kishmish Kazakhstanskii	23.4	110.8	125.3	86.5	16.7	70.7	80.2	55.8	71.4	63.8	64.0	66.4
Jubilei Moldavii × Medeo	21.6	177.2	173.6	124.1	15	129.2	111.4	85.2	69.4	73.0	64.1	68.8
Jubilei Moldavii × Krymskaya Zhemchuzhina	24	152.5	55.0	77.1	15.5	101.0	26.0	47.5	64.6	66.0	47.2	59.2
Olympiada x Muromets	27	100	40.8	55.9	20	75.0	23.5	39.5	74	75.0	57.5	68.8
Moldova × Kyzyl Tan	21.1	112.1	152.0	95.0	14.6	71.2	100.0	61.9	69.2	63.5	65.7	66.1
Kyzyl Tan × Jubilei Moldavii	12	163.7	36.4	70.7	6.5	119.5	18.2	48.0	54.2	72.9	50.0	59.0
Moldova × Krymskaya Zhemchuzhina	21.1	156.7	136.4	104.7	16	111.0	104.3	77.1	75.8	70.8	76.4	74.3
Vierul 59 × Medeo	20.8	106.6		63.7	14.4	79.0	124.0	72.4	69.2	74.1	68.8	70.7
Moldova × Muromets	23.6	108.3	180.1	104	16.7	84.9	96.5	66.0	70.8	78.3	66.6	71.9
Moldova × IX-25/67	23.9	75.3	144.7	81.3	17.3	57.0	74.0	49.4	72.4	75.6	58.2	68.7
IX-25/67 × Krymskaya Zhemchuzhina	25.5	79.5	127.0	77.3	16.5	64.0	25.3	35.2	64.7	80.5	43.8	63.0
Vierul 59 × Olimpiada	21.2	116.8	57.7	65.2	16.2	84.4	83.5	61.3	76.4	72.2	62.8	70.4
Pamyati Negrulya × Muromets	21.1	61.5	132.8	71.8	11.6	42.3	72.4	42.1	54.9	68.7	72.0	65.2
Vierul 59 × Muscat	18.3	67.1	100.5	61.9	11.5	41.3	85.5	46.1	62.8	61.5	68.5	64.2
HCP_{05}					3.8	5.1	6.1	4.0				

Krymskaya Zhemchuzhina, Moldova E Kishmish Kazakhstanskii, Vierul 59 × Kishmish Kazakhstanskii, Moldova × Kyzyl Tan, Moldova × Muromets, Moldova × IX-27/67, IX-27/67 x Krymskaya Zhemchuzhina, Vierul 59 × Olimpiada, Alma-Ata × Kishmish Moldavskii, etc.

In 2014 due to the cold spring the budbreak in the same crossing combinations occurred 2 weeks later than in 2013. The earliest budbreak (24 April) was observed in hybrids resulting from the crossing combinations Jubilei Moldavii × Krymskaya Zhemchuzhina, Kyzyl Tan × Krymskaya Zhemchuzhinaa, Olimpiada × Muromets. The budbreak in the crossing combinations Moldova × X-25/67, Moldova × Krymskaya Zhemchuzhina, Jubilei Moldavii × Medeo, Vierul 59 × Medeo, Moldova × Muromets, X-27/67 x Krymskaya Zhemchuzhina, Vierul 59 × Olimpiada, Pamyati Negrulya x Muromets, Kyzyl Tan × Jubilei Moldavii, Vierul 59 × Muscat Kazakhstanskii was observed 2-4 days later (Table 1).

Summarizing the results received during the three years of observations, the earliest budbreak (15 April) was observed in hybrids resulting from the crossing combinations Olympiada × Muromets, Moldova × Kyzyl Tan. In the rest of the hybrid plants (17-21) the budbreak was observed 3-5 days later (Table 2).

In 2012 the best degree of overwintering (69.4-76.4%) was observed in the hybrids resulting from the crossing combinations Vierul 59 × Medeo, Moldova × Kyzyl Tan, Jubilei Moldavii × Medeo, Moldova × Muromets, Vierul 59 × Kishmish Kazakhstanskii, Moldova × IX-27/67, Moldova × Kishmish Kazakhstanskii, Jubilei Moldavii × Medeo, Olimpiada × Muromets, Moldova × Krymskaya Zhemchuzhina Vierul 59 × Olimpiada. The hybrids resulting from the crossing combinations Jubilei Moldavii × Krymskaya Zhemchuzhina, Kyzyl Tan × Jubilei Moldavii, IX-27/67 × Krymskaya Zhemchuzhina, Pamyati Negrulya × Muromets, Vierul 59 × Muscat, had the degree of overwintering within the range of 54.2-64.7%. The lowest degree of bud overwintering (52.3%) was observed in the crossing combination Alma-Ata × Kishmish Kazakhstanskii (Table 2).

In 2013 the highest degree of overwintering (70.8 -80.5%) was observed in the crossing combinations Moldova E Krymskaya Zhemchuzhina, Vierul 59 × Olimpiada, Kyzyl Tan × Jubilei Moldavii, Jubilei Moldavii E Medeo, Vierul 59 × Medeo, Moldova × IX-25/67, Moldova × Muromets. The lowest degree of overwintering was observed in the crossing combinations Alma-Ata × Kishmish Moldavskii (60.0 %) and Vierul 59 E Muscat (61.5%).

Table 3. Phenological observations of hybrid plants. Hybrid nursery (2012-2014)

Crossing combination	Inception of flowering			
	2012	2013	2014	Average
Moldova × Kishmish Kazakhstanskii	1.06	7.06	09.06	05.06
Alma-Ata × Kishmish Moldavskii	30.05	9.06	08.06	06.06
Vierul 59 × Kishmish Kazakhstanskii	29.05	9.06	10.06	06.06
Jubilei Moldavii × Medeo	31.05	9.06	12.06	07.06
Jubilei Moldavii × Krymskaya Zhemchuzhina	31.05	11.06	07.06	06.06
Olympiada × Muromets	28.05	10.06	06.06	04.06
Moldova × Kyzyl Tan	1.06	7.06	08.06	05.06
Kyzyl Tan × Jubilei Moldavii	31.05	12.06	06.06	06.06
Moldova × Krymskaya Zhemchuzhina	30.05	12.06	11.06	07.06
Vierul 59 × Medeo	1.06	12.06	14.06	09.06
Moldova × Muromets	30.05	13.06	12.06	08.06
Moldova × IX-25/67	1.06	13.06	16.06	10.06
IX-27/67 × Krymskaya Zhemchuzhina	31.05	13.06	11.06	08.06
Vierul 59 × Olimpiada	30.05	12.06	11.06	07.06
Pamyati Negrulya × Muromets	31.05	12.06	11.06	08.06
Vierul 59 × Muscat	31.05	15.06	14.06	10.06

Table 4. Productivity and crop quality

Hybrid form	Date of harvesting	Average bunch weight,g	Crop weight, kg/vine	Sugar content, %	Coloring of berries	Time of ripening	Tasting assessment, points
1	2	3	4	5	6	7	8
2012							
Table varieties							
PI-7/21	20.09	330	5.9	18	black	late	4.5
X-17/90	25.08	350	7.4	18	white	medium	4.6
PI-9/2	23.08	320	6.1	20	white with Muscat flavor	medium	4.4
PI-10/3	15.09	320	6.7	21	black	mid-late	4.7
IX-23/29	13.09	450	10.4	18.5	black	mid-late	4.5
PI-12/13	25.08	290	5.8	18	white	medium	4.5
K I-2/9	24.08	340	5.2	18	white	medium	4.6
Guzal Kara (st)	25.08	280	5.0	18	black	medium	4.2
HCP_{05}		18.5	0.8				
Wine varieties							
D IX-27/60	21.08	210	3.3	22	black	medium	-
DVII-3/61	20.08	170	3.4	23	black	medium	-
DIV-6/23	23.08	200	3.6	22	black	medium	-
D VII-8/45	04.09	190	3.5	24	black	mid-late	-
HCP_{05}		7.6	0.1				
2013							
Table varieties							
PI-7/21	20.09	320	5.9	18	black	late	4.5
X-17/90	25.08	340	7.4	18	white	medium	4.6
PI-9/2	23.08	330	6.1	20	white with Muscat flavor	medium	4.4
PI-10/3	15.09	330	6.7	21	black	mid-late	4.7
IX-23/29	13.09	450	10.4	18.5	black	mid-late	4.5
PI-12/13	25.08	290	5.8	18	white	medium	4.5
D IX-23/20	26.08	350	5.9	19	white	medium	4.8
DV-10/11	25.08	360	6.4	18	white	medium	4.9
K I-2/9	26.08	350	5.9	18	white	medium	4.7
Guzal Kara (st)	25.08	280	5.0	18	black	medium	4.2
HCP_{05}		18.5	0.8				
Wine varieties							
D IX-27/60	21.08	210	3.3	22	black	medium	-
DVII-3/61	20.08	170	3.4	23	black	medium	-
DIV-6/23	23.08	200	3.6	22	black	medium	-
D VII-8/45	04.09	190	3.5	24	black	mid-late	-
HCP_{05}		7.6	0.1				-
2014							
Table varieties							
KI-1/14	05.08	460	5.9	18	rose	early	4.8
KIV-1/52	08.08	480	5.7	17	white	early	4.6
K I-2/9	25.08	340	4.7	18	white	medium	4.8
KIV-1/22	23.08	450	5.8	17	white	medium	4.5
KIV-1/64	27.08	460	4.6	22	rose	medium	4.8
D III-5/54	25.08	430	6.4	20	white	medium	4.5
D IX-23/20	23.08	350	5.2	17	white	medium	4.5
DV-10/11	27.08	350	4.9	17	white	medium	4.8
KII-1/10	05.09	430	5.1	18	white and rose	mid-late	4.5
P I-10/3	07.09	320	4.8	17	black	mid-late	4.5
D I%-23/29	07.09	280	4.4	18	white	mid-late	4.8
D V-7/17	09.09	290	4.6	17	white	mid-late	4.5
HCP_{05}		13.3	0.4				
Wine varieties							
D IX-27/60	20.08	190	3.2	23	black	medium	-
DVII-3/61	22.08	180	3.5	24	black	medium	-
DIV-6/23	25.08	180	3.7	23	black	medium	-
D VII-8/45	07.09	210	3.8	25	black	mid-late	-
HCP_{05}		5.7	0.2				

In 2014 the highest degree of overwintering was observed in the crossing combinations Moldova × Kyzyl Tan, Moldova × Kishmish Kazakhstanskii, Moldova × Krymskaya Zhemchuzhina, Vierul 59 × Medeo, Moldova × Muromets, Pamyati Negrulya × Muromets, Vierul 59 × Muscat (76.4%). The lowest degree of overwintering was observed in the crossing combinations I%-27/67 × Krymskaya Zhemchuzhina (43.8%), Alma-Ata × Kishmish Moldavskii (46.2%) and Jubilei Moldavii × Krymskaya Zhemchuzhina (47.2%).

In 2012-2014 the highest degree of overwintering (71.9-74.3%) was observed in the crossing combinations Vierul 59 × Kishmish Kazakhstanskii, Jubilei Moldavii E Medeo, Olimpiada × Muromets, Moldova × Kyzyl Tan, Moldova × Krymskaya Zhemchuzhina, Vierul 59 × Medeo, Moldova × Muromets. The lowest degree of overwintering (52.8-64.2 %) was observed in the crossing combinations Alma-Ata × Kishmish Moldavskii, Jubilei Moldavii × Krymskaya Zhemchuzhina, Kyzyl Tan E Jubilei Moldavii, IX-25/67 × Krymskaya Zhemchuzhina, Vierul59 × Muscat (Table 2).

Flowering of grapes starts at various times. This is related to the varietal characteristics. The difference in the time of the inception of flowering is usually insignificant. The higher is the temperature, the earlier the flowering starts.

In 2012, the flowering stage in most of the studied hybrid plants was observed during the third ten-day period of May; in the crossing combinations Moldova × Kishmish Kazakhstanskii, Moldova × Kyzyl Tan, Vierul 59 × Medeo, Moldova E IX-25/67 the flowering stage was observed during the first ten-day period of June. As the Table 3 shows, in 2012 the flowering stage began much earlier than in the subsequent 2 years (2013-2014). This can be attributed to the early onset of spring in 2012; rapid rise of the air temperature led to the early inception of flowering (Table 3).

In 2013, the flowering stage began later, due to frequent rains. The flowering stage in the studied hybrid plants Moldova × Kishmish Kazakhstanskii, Alma-Ata × Kishmish Moldavskii, Vierul 59 × Kishmish Kazakhstanskii, Jubilei Moldavii × Medeo, Olimpiada × Muromets, Jubilei Moldavii × Krymskaya Zhemchuzhina, Kyzyl Tan × Jubilei Moldavii, Moldova × Kyzyl Tan was observed in the first ten-day period of June, in the rest of the crossing combinations the inception of flowering was observed in the second ten-day period of June.

In 2014 the earliest inception of flowering (06.06-10.06) was observed in the crossing combinations Moldova × Kishmish Kazakhstanskii, Alma-Ata × Kishmish Moldavskii, Vierul 59 × Kishmish Kazakhstanskii, Jubilei Moldavii × Krymskaya Zhemchuzhina, Olimpiada × Muromets, Moldova × Kyzyl Tan, Kyzyl Tan × Jubilei Moldavii. In the rest of the hybrid plants the inception of flowering was observed in the second ten-day period of June.

Summarizing the results received during the three years of observations, the earliest inception of flowering (4-5 June) was observed in the crossing combinations Moldova × Kishmish Kazakhstanskii, Olimpiada x Muromets, Moldova × Kyzyl Tan. According to the average data for the three years, all the hybrid plants burst into bloom during the first ten-day period of June. The survey of the productivity of the hybrid plants of grapes have also been conducted. According to the percentage of fertile shoots (from 18.6% to 27.8%) the following crossing combinations were singled out: Moldova × Kishmish Kazakhstanskii, Jubilei Moldavii × Krymskaya Zhemchuzhina, IX-27/67 × Krymskaya Zhemchuzhina.

The degree of the resistance of the hybrids to the Uncinula necator was also determined.

In 2012, in the hybrid nursery the signs of the Uncinula necator were discovered in the second ten-day period of July. According to the resistance to the Uncinula necator the following crossing combinations were identified: the hybrids Pamyati Negrulya × Muromets, Moldova x IX-25/17, IX-27/67 × Krymskaya Zhemchuzhina proved to be the most resistant (infestation of 0-1 points); Vierul 59 x Medeo, Moldova × Kyzyl Tan, Moldova × Kishmish Kazakhstanskii were medium resistant (1-2 points); the following varieties were infested (3-4 points): Alma-Ata × Kishmish Moldavskii, Kyzyl Tan × Jubilei Moldavii. Spraying of vines for pest and disease control was carried out

Table 6. Biometric characteristics of hybrid plants (2012-2014)

Crossing combinations	Total increment, m				Average length of the shoots, cm				The degree of the ripening of shoots,%			
	2012	2013	2014	Average	2012	2013	2014	Average	2012	2013	2014	Average
Moldova × Kishmish Kazakhstanskii	25.29	18.99	13.78	19.35	117.2	84.6	114.9	105.6	74.4	74.8	85.3	78.2
Alma-Ata × Kishmish Moldavskii	18.84	18.61	13.41	16.95	109.6	81.7	89.4	93.6	76.6	75.6	75.2	75.8
Vierul59 × Kishmish Kazakhstanskii	23.26	28.14	16.09	22.49	123.6	86.1	100.6	103.4	69.4	57.1	72.5	66.3
Jubilei Moldavii × Medeo	24.47	23.88	19.83	22.73	132.4	114.0	110.2	118.9	80.8	88.0	74.2	81.0
Jubilei Moldavii × Krymskaya Zhemchuzhina	19.41	18.98	20.46	19.61	121.5	98.9	120.4	113.6	76.9	83.3	69.3	76.5
Olympiada × Muromets	20.32	20.86	19.58	20.25	127.0	114.6	108.8	116.8	78.4	82.4	84.2	81.7
Moldova × Kyzyl Tan	18.11	17.38	21.74	19.07	132.2	109.2	120.8	120.7	72.6	81.7	67.2	73.8
Kyzyl Tan × Jubilei Moldavii	13.16	12.96	13.39	13.17	105.2	87.9	95.7	96.3	77.4	84.9	76.2	79.5
Moldova × Krymskaya Zhemchuzhina	18.07	18.00	15.39	17.15	117.2	86.8	102.6	102.2	72.2	74.4	64.6	70.4
Vierul 59 × Medeo	15.82	15.36	18.94	16.71	131.3	108.4	118.4	119.4	77.4	84.9	72.5	78.3
Moldova × Muromets	12.00	12.03	16.02	13.35	101.8	83.5	114.4	99.9	79.9	81.7	70.3	77.3
Moldova × IX-25/67	26.11	24.79	18.68	23.19	141.2	110.4	116.8	122.8	76.4	82.2	67.5	75.7
IX-25/67 × Krymskaya Zhemchuzhina	9.36	9.17	11.23	9.92	70.0	66.6	86.4	74.3	82.3	76.8	67.8	75.6
Vierul59 × Olimpiada	8.01	7.75	13.41	9.72	67.5	67.9	89.4	74.9	89.1	92.5	75.2	85.6
Pamyati Negrulya × Muromets	21.84	8.2 4	12.22	14.10	110.7	53.3	76.4	80.1	86.5	87.0	75.3	82.9
Vierul 59 × Muscat	21.84	21.45	20.09	21.13	128.0	112.8	118.2	119.7	86.5	89.0	72.4	82.6
HCP_{05}	1.0	1.2	0.6	0.8	4.2	3.5	2.6	2.8	-	-	-	-

(Topaz, Ridomil, Aktellik). According to the resistance to the Uncinula necator the following hybrids were single out: IV-6/23, IX-27/60, VII-3/61, VII-3/36.

In 2013-2014 the signs of the Uncinula necator were found in an insignificant amount and only on single vines. Spraying of the vineyard using fungicides and insecticides was carried out (Topaz, Ridomilgold and Aktellik).

Records of biological yield of the hybrid forms of grapes was kept

In 2012 in the hybrid forms of grapes of early ripening KII-2012, P I-6/23, D IX-27/60, D V-12/2 the average bunch weight amounted to 180 g, 170 g, 280 g, the sugar content of the juice of berries was within the range of 15-23%, the acidity amounted to 5.8-6.8 g/l. Records of ripening of berries in the hybrid forms of grapes of mid-late and late ripening were kept. As a result of the study it was found that the full maturity of berries was observed in the hybrid forms of grapes PI-7/21 on the 20th of September, PI-10/3 – on the 15th of September. The tasting assessment of the promising hybrid forms of grapes was conducted using the five-grade scale with determining of the bunch weight, the sugar content and the acidity of the juice of berries. In the selected hybrid forms of grapes the tasting assessment varied within the range of 4.2-4.8 points, bunch weight in D IX-27/60 amounted to 180 g, in DVII-3/61 – 120 g, PI-9/2 – 320 g, P I-12/13 – 290 g, the sugar content of the juice of berries was within the normal range from 16 to 20%, the acidity was within the range from 5.6 to 6.2 g/l.

In 2013 in the hybrid forms of table grapes of mid-late ripening %-17/90, PI-9/2, PI-12/13, D IX-23/20, DV-10/11 the average bunch weight amounted to 340 g, 330 g, 290 g, 350 g, 360 g, the sugar content of the juice of berries was within 15-23%, the acidity was within 5.8-6.8 g/l. In the wine varieties DIX-27/60, DVII-3/61, DIV-6/23 the average bunch weight amounted to 210 g, 170 g, 200 g. The sugar content of the juice of berries was within 22-23%. The full maturity of berries was observed in the period from 20.08 till 25.08.

In 2014, records of biological yield of the hybrid forms of grapes of early ripening KI-1/14, KIV-1/52 were kept; the average bunch weight amounted to 460 g, 480 g, the tasting assessment was 4.8 points; 4.6 points, the sugar content of the juice of berries was 18%; 17%. For submission to the primary variety testing one hybrid form of grapes was selected: K I-2/9.

Records of ripening in the hybrid forms of grapes of mid-late ripening were kept, the tasting assessment of the promising hybrid forms of grapes was conducted with determining of the bunch weight, the sugar content and the acidity of the juice of berries. In 2014, in the hybrid forms of table grapes of mid-late ripening KI-2/9, KIV-1/22, KIV-1/64, DIII-5/54, D IX-23/20, DV-10/11 the average bunch weight amounted to 340 g, 450 g, 460 g, 430 g, 350 g, the sugar content of the juice of berries was within 17- 22%, the acidity was within 5.8-6.5 g/l, the tasting assessment was 4.5-4.8 points. In the wine varieties DIX-27/60, DVII-3/61, DIV-6/23 the average bunch weight amounted to 200 g, 160 g, 180 g. The sugar content of the juice of berries was within 23-27%. The full maturity of berries was observed in the period from 20.08 till 30. 08.

Records of ripening of berries in the hybrid forms of grapes of mid-late and late ripening were kept. The tasting assessment of the promising hybrid forms of grapes was conducted with determining of the bunch weight, the sugar content and the acidity of the juice of berries (Table 5).

In the hybrid forms KII-1/10, P I-10/3, D IX-23/29, D V-7/17 the tasting assessment varied within the range of 4.5-4.8 points, the average weight of bunches amounted to 430 g, 320 g, 280 g, 290 g, the sugar content of juice was within the range of 17-21%, acidity amounted to 6.0-6.5 g/l. Based on the complex of economically valuable traits two hybrids were singled out: PI-9/2, P I-10/3.

The evaluation of biometric characteristics of the one-year growth of hybrid grapes was carried out, which is typically conducted in the sixth phase of thevegetation period. The shoots accumulate reserve constituents. Mature shoots can withstand temperatures down to -18°C.

By the fall of 2012, the total increment of the hybrid plants was not equal and varied within the range of 12.00-26.11 m/vine. The highest total

increment was observed in the crossing combinations Moldova × IX-25/67-26 (11 m/vine), Moldova × Kishmish Kazakhstanskii (25.29 m/vine), Jubilei Moldavii × Medeo (24.47 m/vine), in the rest of the hybrid plants it was less significant: Moldova × Muromets, Kyzyl Tan × Jubilei Moldavii – 12.00-13.16 m/vine.

The average length of one-year shoots of the hybrid plants amounted to: Moldova × IX-25/67-141.2 cm, Jubilei Moldavii × Medeo-132.4 cm, Moldova × Kyzyl Tan – 132.2 cm. In the other hybrid plants it was somewhat less: Moldova × Muromets, Vierul 59 × Muscat Kazakhstanskii – 101.8-128.0 cm respectively. The highest degree of the ripening of shoots was observed in the hybrids resulting from the crossing combinations Vierul 59 x Muscat Kazakhstanskii, Jubilei Moldavii E Medeo, Moldova x Muromets (86.5%, 80.8%, 79.9% respectively); the lowest degree of the ripening of shoots was observed in Vierul 59 x Kishmish Kazakhstanskii (Table 5).

In 2013, the total increment of the hybrid plants varied within the range of 12.03-24,79 m/vine. The highest increment values were observed in the crossing combinations Moldova E IX-25/67 (24.79 m/vine), Moldova E Kishmish Kazakhstanskii (18.99 m/vine), Jubilei Moldavii E Medeo (23.88 m/vine); somewhat smaller increment was observed in the crossing combinations Vierul 59 x Olimpiada, Pamyati Negrulya x Muromets (7.75-8.25 m/vine).

The highest degree of the ripening of shoots was observed in the hybrids resulting from the crossing combinations Jubilei Moldavii E Medeo, Vierul 59 x Medeo, Kyzyl Tan x Jubilei Moldavii (88.0%, 84.9%, 84.8% respectively); the lowest degree of the ripening of shoots was observed in the crossing combination Moldova E Krymskaya Zhemchuzhina – 74.4% (Table 6).

In 2014, the total increment of the hybrid plants varied within the range of 11.23-21.74 m/vine. The highest increment values were observed in the crossing combinations Jubilei Moldavii E Medeo (19.83 m/vine), Jubilei Moldavii E Krymskaya Zhemchuzhina (20.46 m/vine, Olimpiada x Muromets (19.58 m/vine), Moldova E Kyzyl Tan (21.74 m/vine), Vierul 59 x Medeo (18. 94 m/vine); somewhat smaller increment was observed in the crossing combinations Moldova × Kishmish Kazakhstanskii (13.78 m/vine), Alma-Ata × Kishmish Moldavskii (13.41 m/vine), Kyzyl Tan E Jubilei Moldavii (13.39 m/vine), Moldova E Krymskaya Zhemchuzhina (15.39 m/vine), IX-25/67 E Krymskaya Zhemchuzhina (11.23 m/vine), Vierul 59 × Olimpiada (13.41 m/vine), Pamyati Negrulya × Muromets (12.22 m/vine).

The highest degree of the ripening of shoots was observed in the hybrids resulting from the crossing combinations Olimpiada × Muromets, Vierul 59 × Olimpiada, Pamyati Negrulya x Muromets, Vierul 59 E Muscat (81.7-85.6%); the lowest degree of the ripening of shoots was observed in the crossing combination Vierul 59 × Kishmish Kazakhstanskii (66.3%) (Table 6).

CONCLUSIONS

The study found that the most valuable grape varieties with regard to the complex of economically-valuable traits suitable for the submission to the primary variety testing are the hybrid forms of grapes PI-7/21, PI-9/2, PI-10/3, P I-10/31, P I-12/13, DIV-6/23, D IX-27/60, DVII-3/61,KV-2/35, KIII-3/39.

Based on the results of the research carried out in 2012-2014, two new grape varieties were submitted to the State variety testing: Akzhayyk (K I-2/9), received by crossing between varieties Nimrang E Cardinal, and Meiram-55 (DVII-8/45), received by crossing between varieties Fioletovyi Rannii E Ilijskii.

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