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Selection of Cultivar-rootstock Combinations of Diploid Plum (*Prunus rossica* Erem.) for Arid Conditions in Southern Russia

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ABSTRACT

Background: Plum diploid is a new species for the conditions of the Volgograd region of Russia, not previously grown. There are a large number of varieties and rootstocks that need to be studied in relation to new growing conditions.

Methods: The research was carried out in 2020-2022. Drought resistance and heat resistance were determined by laboratory method. To account for these indicators, the water content of the leaf, the water deficit and the water-holding capacity of the leaves were determined. Productivity and fruit quality were determined by the weight method. Statistical analysis in the standard Microsoft Excel 2013 software package.

Result: The study of the productivity of variety-rootstock combinations has shown that it is significantly influenced by, in addition to varietal characteristics, external environmental factors, also the rootstock on which the variety is grafted. The rootstock affects the strength of growth, the time of entry into fruiting, the quality characteristics of fruits, which significantly affects productivity. The highest productivity was observed in the Sarmatka variety on the VVA-1 rootstock (21.5 kg/tree), the smallest was the Kuban Comet on the cherry plum rootstock (10 kg/tree).

Key words: Cherry plum, Diploid (Russian) plum, Frost resistance, Productivity, Rest period, Winter hardiness.

INTRODUCTION

Plum is one of the most adaptive stone crops, differing from other fruit crops by relatively high drought resistance, winter hardiness, high productivity and fruiting stability (Meland and Maas, 2017; Bogdanov *et al*., 2021; Ozhereleva *et al*., 2021). However, there are about 20 main types of plum, some of which have not yet been sufficiently studied. One of these species is a new species - Russian plum (*Prunus rossica* Erem.), which has recently, especially in Russia, become increasingly popular, which is obtained as a result of purposeful distant hybridization between Chinese plum and cherry plum (Eremin *et al*., 2018; Safarov and Eremin, 2020).

Russian plum is valued for its high yield, early fruitfulness, comparative undemanding to growing conditions, as well as good taste and marketable qualities of fruits. Due to its high polymorphism, this species has a wide range of adaptability to various conditions, which makes it a convenient object for introduction and selection (Fedorova and Upadysheva, 2014; Fedorova and Upadysheva, 2017; Milošević and Milošević, 2018; Đordevic *et al*., 2019). Currently, breeders have obtained many varieties of diploid (Russian) plum, allowing to harvest from the first decade of July to the third decade of September, with the possibility of laying the fruits of late varieties for long-term storage. At the same time, the fruits of different varieties differ in shape, color, maturity, storage, etc (Đordevic´ *et al*., 2016; Vasilyeva and Matveev, 2017; Ohata *et al*., 2018; Cerovic *et al*., 2021). The disadvantages of this species include an early exit from the winter dormancy period, which often leads to a root neck, damage to flower buds by recurrent frosts and as a result, a decrease or complete loss of harvest.

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At the same time, the use of various rootstocks can significantly increase the adaptive potential, reduce the habit, increase the productivity and quality of fruits, as well as speed up the time of entry into fruiting of varieties grafted on them (Solonkin *et al*., 2019; Eremin and Eremin, 2020; Bettini-Tambur *et al*., 2022; Solonkin *et al*., 2022).

The study of the existing variety of varieties and rootstocks will make it possible to identify varietal-rootstock combinations of diploid plum that are the most drought-resistant and winter-hardy, capable of increasing the winter dormancy period for stable fruiting (Sharma *et al*., 2018).

MATERIALS AND METHODS

The experimental site is located on the territory of the Laboratory of Breeding, Seed Production and nursery Breeding of the Federal Research Center of Agroecology of the Russian Academy of Sciences, Russia, in the dry-steppe zone of the Volgograd region, on the right bank of the Volga River. The soil is slightly alkaline light chestnut, light mechanical composition, humus content is low -1.73%, pH = 7.2-7 (Solonkin *et al.,* 2022).

The experiment was conducted from 2020 to 2022. For study, the following combinations of diploid plum on clonal rootstocks were planted on the experimental plot in the spring of 2015 by one-year-olds. The graft and rootstock material was obtained from the Crimean Experimental Breeding Station, a branch of the N.I. Vavilov All-Russian Research Institute of Plant Breeding, Russia. The material was grafted in the nursery, seedlings were grown and later planted in a permanent place in the garden. Interspecific hybrids VVA-1 and VSV-1 were taken as rootstock. Cherry plum seedlings served as control. The following varieties of Russian plum were studied: Kuban comet, Sarmatka, Melon, Globe. The Kuban Comet variety was chosen as a control variant, because this variety has been cultivated in this area for many years and has shown itself to have high adaptive stability and good quality characteristics (Nikolskaya and Solonkin, 2021).

The layout of trees in the garden is 5 meters between rows and 2 meters between trees in a row (1000 trees per 1 hectare). The scheme of the experiment included four varieties, three rootstocks and four replications, all plants were arranged randomly. In total, there were 48 trees in the test (twelve varietal-rootstock combinations in four repetitions).

The high aridization of the growing conditions in which the experimental site is located requires the arrangement of additional irrigation. In this regard, experimental plantings were irrigated weekly at a rate of 160 to 200 m^3/ha, depending on the prevailing weather conditions, with drip garden lines with emitters of 2 liters/hour, a distance of 60 cm (NETAFIM, Israel). The trees were formed according to the free-growing bowl system. Care activities in the garden were carried out according to the generally accepted technologies for the care of stone plantings in the south of Russia (Zaremuk *et al*., 2016). The soil in the aisles during the growing season was kept under black steam, treated with a disc harrow (BDM-3, Russia) as weeds grew.

Drought resistance and heat resistance were carried out by laboratory method. To account for these indicators, the water content of the leaf, the water deficit and the water-holding capacity of the leaves were determined (Sedov *et al* 1999; Fedorova and Upadysheva, 2017; Ozhereleva *et al*., 2019).

Heat resistance

Samples consisting of five leaves each were placed in a water bath (LW-8, BYTOM-LAGIEWNIKI, Poland) at a temperature of 50, 55, 60°C for 10 minutes. Then the leaves were cooled and lowered into 0.1 H hydrochloric acid solution for 10 minutes. According to the degree of browning of the leaf tissues (% of the total area), the degree of stability of the sample was determined.

Fruit productivity and qualitywere determined by the weight method Sedov (1999).

The productivity of the variety-rootstock combination was calculated relative to biometric parameters: crown projection area (S), crown volume (V), stem cross-sectional area (S).

This technique was described in more detail earlier (Sedov, 1999; Fedorova and Upadysheva, 2017).

The data obtained for various studied features were analyzed by the method of variance analysis described in the methodology of B. A. Dospekhov on a personal computer using Microsoft Excel 2013 application software packages.

RESULTS AND DISCUSSION

Water–holding capacity of plum leaves on various rootstocks at critical summer temperatures (39.2°C-40.2°C), average for three years

The analysis of the water-retaining ability of leaves, which characterizes the resistance of plants to temperature stresses of the summer period, showed the dependence of this parameter not only on the prevailing weather conditions, but also on the rootstock. For almost all varieties, the most stable resistance, without sharp fluctuations over the years, was the VVA-1 rootstock. This is especially evident in the Sarmatka variety (Table 1). For the rest of the rootstocks, there was a variation in water retention capacity, depending on the prevailing weather conditions. The lowest rate of moisture loss was recorded in 2022, when a cool summer period was observed, against which leaf transpiration decreased. According to the varieties, the lowest moisture losses were observed in the Sarmatka variety, characterizing this variety as the most resistant to extremely high summer temperatures and having increased drought resistance (Table 1).

The rest of the studied varieties had average indicators of drought resistance. Our data differ from the data obtained by Safarov R. and Eremin G. in the Krasnodar Territory, since the climate of this zone differs significantly from the climate of the Volgograd region, which once again confirms the need to study plants under certain conditions (Safarov and Eremin, 2020).

Biometric indicators of plum cultivar-rootstock combinations

By the time of the study, the variety-rootstock combinations were 7 years old and entered the period of full fruiting, i.e. the main growth processes and the formation of crown trees had already been completed. The maximum values for tree height, crown diameter, stem diameter and others were observed on all varieties on the cherry plum rootstock, with the exception of the Sarmatka variety. The smallest biometric indicators were noted for Melon varieties on the VVA-1 rootstock, for Globus and Kuban Comet varieties - on the VSV-1 rootstock (Table 2). The study of biometric parameters contributes to the most rational placement of trees in the garden, the selection of planting schemes depending on the rootstock and the most efficient use of the garden plot area, which is confirmed by many studies (Guerra *et al*., 2011; Vasilyeva and Matveev, 2017; Milošević and Milošević, 2018; Eremin and Eremin, 2020; Bettini-Tambur *et al*., 2022).

Yield of Russian plum varieties on various rootstocks

The analysis of the productivity of the studied variety-rootstock combinations showed a variation in yield, both among the studied varieties and among the rootstocks within the variety (Table 3).

Note. Cv is the coefficient of variation, SD is the standard deviation, M is the arithmetic mean, Sx is the relative standard error of the sample mean.

The highest yield, both on average for three years and by years, was shown by the variety Sarmatka (21.5 kg/d.),

Table 1: Water-holding capacity of plum leaves on various rootstocks at critical summer temperatures (39.2°C-40.2°C), average for three years (2020-2022).

Variety	Rootstock	Water scarcity, %	Weight before drying, g	Loss of water by leaves after 6 hoursof withering, %			
				2020	2021	2022	Average for 3 years
Sarmatka	Cherry plum	22.53	1.99	21.5	17.9	21.69	20.36
	VVA-1	24.53	1.28	21.8	24.1	23.42	23.11
	VSV-1	22.0	2.19	23.5	34.1	13.9	23.83
	Average	23.02	1.82	22.3	25.4	19.67	22.43
Melon	Cherryplum	18.53	1.56	24.5	27.5	21.74	24.58
	VVA-1	28.3	1.62	30.0	26.8	22.8	26.53
	VSV-1	34,.5	1.84	31.3	33.9	23.61	29.60
	Average	27.11	1.67	28.6	29.4	22.72	26.9
The globe	Cherryplum	21.36	1.73	23.5	28.5	17.37	23.12
	VVA-1	24.5	1.49	34.0	37.8	23.88	31.89
	VSV-1	14.97	1.64	28.9	32.0	23.12	28.0
	Average	20.18	1.62	28.8	32.8	21.46	27.67
Kuban Comet	Cherryplum	15.1	1.83	28.8	26.4	14.6	23.27
	VVA-1	23.43	1.35	32.4	29.8	25.0	29.07
	VSV-1	27.47	1.29	35.7	25.9	23.45	28.35
	Average	22.0	1.49	32.3	27.4	21.02	26.89
HCP_{05}	-	1.15	-	1.4	1.43	1.06	1.30

Table 2: Biometric indicators of plum cultivar-rootstock combinations, 2022.

Variety	Rootstock	Tree height, m	Crown diameter, m	Diameter of the stem, cm	Crown projection area, m^2	Crown volume, m^3	Cross-sectional area of the stem, cm^2
Sarmatka	Cherryplum	2.2	1.7	7.00	2.27	1.66	38.46
	VVÀ-1	2.3	2.5	8.92	4.9	3.76	62.45
	VSV-1	2.45	2.5	9.39	4.9	4.01	69.21
Melon	Cherryplum	3.03	3.33	9.46	8.7	8.79	70.22
	VVA-1	2.27	2.4	8.37	4.52	3.42	54.99
	VSV-1	2.4	2.7	13.06	5.72	4.58	133.89
The globe	Cherryplum	2.3	2.65	10.67	5.51	4.23	89.37
	VVA-1	2.8	2.7	9.55	5.72	5.34	71.59
	VSV-1	2.0	2.3	7.16	4.15	2.77	40.24
Kuban Comet	Cherryplum	2.55	2.95	4.68	6.83	5.81	17.34
	VVA-1	2.4	2.45	9.39	4.71	3.77	69.21
	VSV-1	2.5	2.3	6.69	4.15	3.46	35.13
HCP_{05}	-	0.12	0.12	0.43	0.26	0.21	3.1

the smallest - Kuban Comet (11.4 kg/d). Among the rootstocks, the highest productivity for all varieties was noted on VVA-1 (Table 3). In the experiments of other researchers and in our experiments on other types of plum, this rootstock also shows good results, which characterizes it as one of the best rootstocks for stone crops (Fedorova and Upadysheva, 2014; Zaremuk, 2015; Solonkin *et al*., 2019; Safarov and Eremin, 2020; Eremin and Eremin, 2020).

Dendrogram of similarity of cultivar-rootstock combinations of prunus × rossica Erem

The grouping of Prunus × rossica Erem cultivar-rootstock combinations is represented on a dendrogram obtained by Ward clustering algorithm, where the measure of connection was Euclidean distance (Fig 1). The resulting cluster consisted of two groups.

Table 3: Yield of Russian plum varieties on various rootstocks, 2020-2022, (Planting scheme 5×2 m).

Variety	Rootstock	Average weight of the fruit, g				Yield kg/tree				kg (2022)	
		2020	2021	2022	Av.	2020	2021	2022	Av.	Scr.	Vst.
Sarmatka	Cherryplum	31.5	30.1	30.5	30.7	18.5	19.1	22.1	19.9	9.73	13.31
	VVA-1	33.1	30.1	31.2	31.5	19.5	18.9	29.3	22.6	5.98	7.79
	VSV-1	33.7	31.2	30.2	31.4	21.8	19.7	24.9	22.1	5.08	6.21
	Average	32.4	30.8	30.6	31.2	20.0	19.2	25.4	21.5	-	-
Melon	Cherryplum	21.9	29.7	29.1	26.9	13.7	13.9	14.2	13.9	1.63	1.61
	VVA-1	34.7	31.2	32.1	32.7	15.6	15.1	15.5	15.4	3.43	4.53
	VSV-1	33.8	33.1	32.3	33.1	14.9	15.2	14.9	15.0	2.60	3.25
	Average	30.1	31.3	31.2	30.9	14.7	14.7	14.9	14.8	-	-
The globe	Cherryplum	33.2	32.9	32.8	33.8	11.5	13.1	14.4	13.0	2.61	3.40
	VVA-1	35.6	32.6	35.1	34.4	12.3	12.3	16.1	13.6	2.81	2.91
	VSV-1	37.3	35.1	36.2	36.2	11.7	12.6	15.4	13.2	3.71	5.56
	Average	35.4	33.5	34.7	34.8	11.8	12.7	15.3	13.3	-	-
Kuban comet	Cherryplum	25.6	22.6	25.2	24.5	10.7	9.1	10.2	10.0	1.49	1.75
	VVA-1	36.7	26.7	31.4	31.6	13.7	11.9	11.9	12.5	2.53	3.16
	VSV-1	36.4	23.9	33.7	31.3	11.7	10.7	12.5	11.6	3.01	3.61
	Average	32.9	24.4	30.1	29.1	12.0	10.6	11.5	11.4	-	-
$HCP_{0.5}$		1.98	1.8	1.6	1.6	0.7	0.7	0.8	0.8		
SD, %		12.6	12.9			3.29	2.88				
Ìaverage		37.9	33.9			13.8	13.4				
Cv, %		0.33	0.38			0.24	0.21				
Sx, %		3.15	3.22			0.82	0.72				

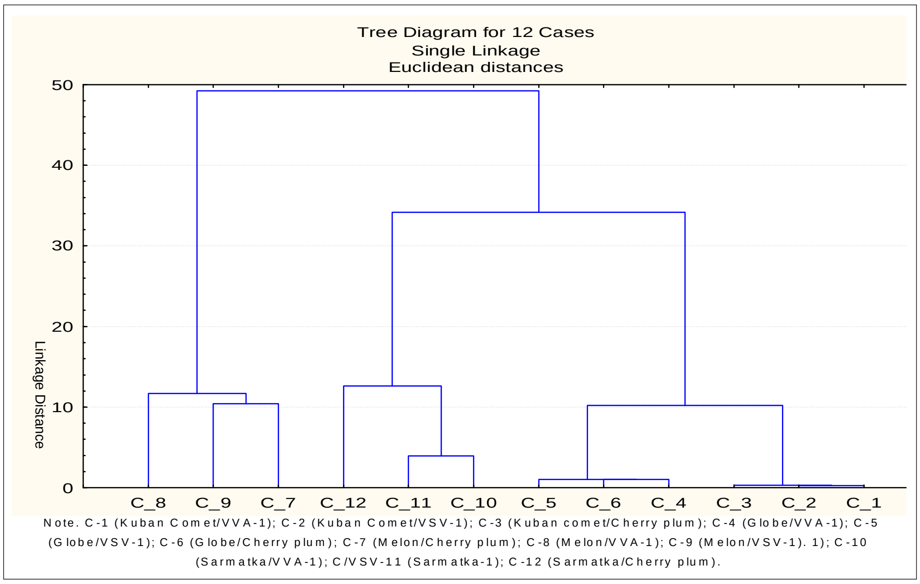

Fig 1: Dendrogram of similarity of cultivar-rootstock combinations of Prunus × rossica erem.

In the cluster analysis, 4 characteristics were included in the basis of the groupings: drought resistance, degree of fruiting, average weight of one fruit, yield from a tree.

After statistical processing of the data of cultivar-rootstock plum combinations by cluster analysis, it was found that three well-distinguishable clusters are distinguished in this general population.

In the first cluster there are 4 cultivar-rootstock combinations that have a high combination of the studied characteristics: drought resistance (3.1 g), degree of fruiting (5 points), high fruit size - the average weight of one fruit (g), high yield per tree (kg per tree).

Cluster 2 is represented by three varieties-rootstock combinations. These samples have the following characteristics: drought resistance (2.47 g), degree of fruiting (4.8 points), average weight of one fruit (25.1 g), yield from a tree (10.3 kg from a tree).

Cluster 3 has 8 combinations. It includes the Kuban Comet/VVA-1, Globus/VVA-1, Globus/VSV-1, Globus/Cherry plum, Melon/VSV-1, Melon/VVA-1, Sarmatka/VVA-1 and Sarmatka/VSV-1. These cluster samples are characterized by average drought resistance (2.70 g), degree of fruiting (4.9 points), average weight of one fruit (33.2 g), yield from a tree (13.4 kg from a tree).

For all Prunus × rossica Erem. cultivar combinations, the significance level is less than 0.05 and, consequently, the null hypothesis of equality of averages for the selected clusters is rejected.

The variation between the selected clusters exceeds the intra-class variation. The F-statistic values obtained for each trait are an indicator of how well the corresponding trait separates the clusters.

CONCLUSION

Thus, the study of variety-rootstock combinations of diploid plum in the arid conditions of southern Russia showed a significant variation in varieties in terms of drought resistance and productivity, depending on the rootstock. The studied rootstocks, being derivatives of different types of plums, both wild and cultivated, had a significant impact on the varieties grafted onto them. Varietal-rootstock combinations of the diploid plum Prunus × rossica Erem., the most stable and fruit-bearing when cultivated in arid conditions, were identified. For each variety-rootstock combination, the most optimal and efficient schemes for placing trees in the garden are recommended, allowing to achieve the maximum yield of products per unit area. An integrated approach to studying the combination of varieties and rootstocks in difficult soil and climatic conditions and the results obtained allow us to recommend the most adaptive and productive combinations for industrial cultivation.

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Conflict of interest: None.

REFERENCES

Bogdanov, R.E. and Bogdanov, O.E. (2021). Evaluation of the yield of hybrid plum forms. In the collection: The contribution of science and practice to ensuring the food security of the country with its technogenic development. Collection of Scientific Papers of the International Scientific and Practical Conference. 82-84.

Bettini-Tambur, B.A., Fernando, A.A., Mariangela, C.Y., Soares, M.B., Bernardes, Martins, M.H. and Schinor, E.H. (2022). Degree days, phenology and fruit quality of ‘Tahiti IAC-5’ acid lime grafted onto different rootstocks in Pindorama -SP. Rev. Bras. Frutic., Jaboticabal. 44(1): (e-064).

Cerovic, R., Akšic, M.F., Đordevic, M. and Meland, M. (2021). The effects of pollinizers on pollen tube growth and fruit set of European plum (*Prunus domestica* L.) in a Nordic climate. Sci. Hortic. 288: 110390. Doi: 10.1016/j.scienta.2021.110390.

Đordevic, M., Cerovic, R., Radicevic, S., Nikolic, D., Miloševic, N., Glišic, I., Maric, S. and Lukic, M. (2019). Pollen tube growth and embryo sac development in ‘Pozna Plava’ plum cultivar related to fruit set. Erwerbs-Obstbau. 61: 313-322.

Đordevic, M., Cerovic, R., Radicevic, S., Nikolic, D., Maric, S., Milosevic, N. and Glišic, I.S. (2016). Influence of pollination mode on fruit set in plum (*Prunus domestica*). Acta Hortic. 1139: 347-352.

Eremin, G., Solonkin, A., Eremina, O., Smirnova, E. and Chepinoga, I. (2018). Catalogue of passports of donors and sources of breeding-significant signs of stone crops. Federal Scientific Center of Agroecology of the Russian Academy of Sciences. pp. 76.

Eremin, G.V. and Eremin, V.G. (2020). Clonal rootstocks for intensive technologies of plum, peach and apricot cultivation in the North Caucasus. Fruit Growing and Viticulture of the South of Russia. 64(4): 106-117.

Fedorova, N.A. and Upadysheva, G.Y. (2014). Frost resistance of diploid plum on different clonal rootstocks during freezing under controlled conditions. Fruit and Berry Growing in Russia. 39: 240-243.

Fedorova, N.A. and Upadysheva, G.Y.U. (2017). Productivity of diploid plum and its relation to the main agrobiological indicators of fruit and berry growing in Russia. Fruit and Berry Growing in Russia. 50: 287-290.

Meland, M. and Maas, F.M. (2017). Regulation of fruiting in plum production. In Proceedings of the 6th Conference, Innovation in Fruit Growing, Faculty of Agriculture: Belgrade, Serbia. 51-67.

Milošević, T. and Milošević, N. (2018). Plum (Prunus spp.) Breeding. Advances in Plant Breeding Strategies: Fruits. Springer, Cham. 165-215.

Nikolskaya, O. and Solonkin, A. (2021). Dormant phases and winter hardiness of diploid plums in the lower Volga region. Scientific and Agronomic Journal. 4(115): 42-47.

Necklace, Z., Prudnikov, P., Panfilova, O., Golyaeva, O., Gulyaeva, A., Levgerova N., Makarkina M. and Galasheva A.M. (2019). To identify new genotypes (Selected and elite seedlings) of fruit and berry crops that exceed the zoned varieties according to the complex of economically valuable traits. Research report. Ministry of Science of Higher Education of the Russian Federation. 148c.

Ohata, K., Togano, Y., Matsumoto, T., Uchida, Y., Kurahashi, T. and Itamura, H. (2018). Selection of prune (*Prunus domestica* L.) cultivars suitable for the East Asian temperate monsoon climate: Ripening characteristics and fruit qualities of certain prunes in a warm Southwest Region of Japan. Hortic. J. 86: 437-446.

Ozhereleva, Z.E., Ozhereleva, Z.E. and Gulyaeva, A.A. (2021). The resistance of the generative organs of cherries to spring frosts during artificial freezing South of Russia. Ecology, Development. 2(59): 45-54.

Safarov, R. and Eremin, G. (2020). Selection of graft-rootstock combinations of Russian plum for intensive cultivation technologies. Fruit and Berry Growing in Russia. 61: 142-145.

Sedov, E.N. and Ogoltsova, T.P. (1999) Program and methodology of variety study of fruit, berry and nut bearing. Orel: VNIISPK. 608.

Sharma, D.D., Kumar, M., Singh, N. and Shylla, B. (2018). Plant growth and fruiting behavior of newly introduced plum (*Prunus salicina* Lindl.) cultivars under mid-hills conditions of Himachal Pradesh. Pharm. Innov. J. 7: 408-413.

Solonkin, A.V., Nikolskaya, O.A. and Kikteva, E.N. (2019). Preliminary assessment of plum cultivar-rootstock combinations in the conditions of the Lower Volga region. Izvestiya of Lower Volga AgrouniVersity Complex: Science and Higher Professional Education. 1(53): 105-113.

Solonkin, A., Nikolskaya, O. and Seminchenko, E. (2022). The effect of low-growing rootstocks on the adaptability and productivity of sour cherry varieties (*Prunus cerasus* L.) in arid conditions. Horticulturae. 5(8): 400. https://doi.org/10.3390/Horticulturae 8050400.

Vasilyeva, M.N. and Matveev, V.A. (2017). The role of introduced varieties of diploid plum species as a source material in the selection of cultural cherry plum in Belarus. Collection of Scientific Papers of the State Nikitsky Botanical Garden. 144(1): 110-113.

Zaremuk, R., Ulianovskaya, E., Artyuk, S., Alyokhina, E., Mozhar, N., Lugovskoy, A., Bogatyreva, S. and Yakovenko, V. (2016). Scientific support of southern horticulture with domestic varieties of garden crops in the aspect of import substitution. Scientific works of the North Caucasus Zonal Research Institute of Horticulture and Viticulture. 10: 50-55.

Zaremuk R. and Sushkov D. (2015). Optimal garden designs based on productive variety-rootstock plum combinations. Scientific Works of the North Caucasus Zonal Research Institute of Horticulture and Viticulture. 8: 48-52.