

Prospective plum cultivars suitable for processing from the local gene fund and selected in plum experimental station – Dryanovo

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Abstract

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During the period 2019–2021, a study was made of the local plum cultivars and cultivars selected in an experimental station on plum Dryanovo, in order to demonstrate their valuable biological and economic qualities, such as high fertility, superior taste qualities, high content of dry matter and sugars and the different ripening periods of the fruits. Flowering phenology and ripening periods, biometric and biochemical properties of fruits, yield and technological suitability were analyzed. The described plum cultivars, due to their good taste qualities, similar to the Kyustendilska variety, are suitable for fresh consumption, drying in various types of dryers, processing into jam, marmalades and distillates. The results give us reason to recommend the local and selected cultivars for wider distribution and to include them in intensive and sustainable orchards.

Keywords: local plum cultivars; phenology; pomology; biometrics; technological suitability

Introduction

The impact of modern agriculture, the modification of basic factors of the agroecological characteristics of the regions and anthropogenic activities have an extraordinary impact on the plant genetic resources, the origin and the diversity of cultural species, which necessarily need conservation approaches. Better coordination of efforts to conserve such species, cultivars and forms *in situ* is needed. They are characterized by resistance to the abiotic conditions in which they are adapted, resistance to economically significant diseases and enemies, ensuring ecologically clean fruit production, through less use of chemicals and generally high fruitfulness and suitability for storage or processing of fruit production.

The diversity of a cultivated species and its wild relatives that can cross and hybridize and produce fertile offspring is called the geneplasm (genetic base) and is of great importance to plant growth because it carries genes that have potential value for improving yield, quality, and adaptation to the environment, including biotic and abiotic stress. The pro-

motion of sustainable crops and cultivars and livelihood diversification is important because of the increasing frequency of natural anomalies affecting the agricultural sector and their impact on yield security (Pathirana & Carimi, 2022).

The Central Balkan Mountain area is rich in local fruit species, including plums adapted to the climate and resistant to diseases, but many of them are at risk of extinction. These traditional local forms, cultivars and wild relatives can be donors of desirable traits in the creation of new cultivars, and this obliges us to preserve the wealth of plant genetic resources in the field of fruit growing and related traditional agricultural practices.

In various regions of Northern Bulgaria, and mainly in the Central Balkan Mountain region, there is a wide variety of local plum cultivars and forms. Once these cultivars were widespread in the yards and orchards of private farmers (Dragoyski et al., 2012). Today, most of them have disappeared or single trees are found. Many of them have valuable biological and economic qualities. These cultivars have been preserved due to their increased resistance to typical eco-

nomically important plum diseases, and also because of their resistance to some abiotic factors, such as drought resistance and cold resistance. These qualities make them very valuable from an ecological point of view (Marinova et al., 2015).

At the Plum Experimental Station in the town of Dryanovo, the collection and research of local plum cultivars and forms began as early as 1929. Later, in 1950-1955, the first collection plantation with selected cultivars was created. Marinov (1961) published detailed data on the biological characteristics of 50 local plum cultivars. Using some valuable qualities of these cultivars, Vitanov (1977) successfully included them in genetic and selective studies on plums. Ivanova (2006) made a biological characterization of 30 local plum cultivars, in PES – Dryanovo, and found a high degree of tolerance of many of the cultivars to the economically important fungal diseases and to sharka (Plum pox virus), which makes some of them suitable for organic production. The greatest interest for complex resistance to the economically important diseases of plums is represented by *Drebna byala rakiinica* and *Byala Razgradska*. Practical resistance to rust was found in *Drebna byala rakiinica* and *Pestilka* (Marinova et al., 2015). From studies by Stefanova et al. (2016) by using a serological ELISA-test from leaf samples of several local plum cultivars, it was established that *Turkulka*, *Drebna byala rakiinica*, *Medenka* and *Summer damson plum* from Elena showed resistance to sharka (Plum pox virus) in a high infection background.

The collection created in 1955 at the Plum Experimental Station in the town of Dryanovo and later renewed in 1985 and 2000 contains a large number of local plum cultivars and is unique because it represents a kind of gene bank.

In the present research, the local plum cultivars (*Prunus domestica* L.) are included, such as *Drebna byala rakiinica* and *Byala Razgradska*, *Pestilka*, *Sakarka* and the *Gabrovska* and *Strinava* cultivars selected by Marko Vitanov.

The aim is to demonstrate the biological and economic qualities in order to reveal the opportunities for their wider distribution and inclusion in organic fruit production.

Material and Methods

The experiment was carried out in the period 2019 – 2021, in Plum Experimental Station – Dryanovo, where in 1995 a collection plantation was created with local plum cultivars and forms, grafted on a plum cherry rootstock (*Prunus cerasifera*, Ehrh) with a planting scheme of 7×5 m. The crowns are free-growing. Cultivation takes place according to generally accepted technology for fruit production, with the necessary agrotechnical events, but without fertilizing and plant protection. 6 trees of each cultivar were studied.

The soil in the experimental area is pseudopodzolic, gray forest, the altitude is 300 m.

The main indicators of the study include:

- blossoming phenology, fruit ripening period,
- reproductive indicators:
 - average weight of fruit and stone (g)
 - fruit sizes (mm) and shape (in a sample of 30 fruits (Nedev et al., 1979);
 - yield per tree (kg)
- biochemical indicators – dry matter content (%), determined refractometrically.

Results and Discussion

The following cultivars are the objective of the study:

Drebna byala rakiinica. It is widespread in the region of Gabrovo, Sevlievo, Dryanovo. The fruits are small-sized with an inverted egg shape. The fruit skin is amber-yellow in color and has an abundant wax coating. The fruit flesh is yellow, very juicy, sweet, without aroma. The fruit stone is not separated from the pulp. The fruits ripen in the second ten days of August. It is suitable for the production of brandy.

Byala Razgradska. It is widespread in the Razgrad region, from where it takes its name. Later it was transferred to the region of the town of Elena. The tree has a moderate growth, weaker than that of Stanley. The fruits are average-sized, with an ellipsoid shape. The fruit skin is amber-yellow in color and has an abundant wax coating. The fruit flesh is golden yellow, soft, sweet, with very good taste. The stone is not separated from the flesh. The fruits ripen in the first half of August. It has good fruitfulness. The fruits of this cultivar are suitable for fresh consumption, for compotes, jams, sweets, as well as for the production of brandy (Ivanova et al., 2015).

Sakarka. It was discovered in the Sakar mountain region, where its name comes from. Later it also spread in Gabrovo. The fruits are dark blue in color and are covered with a thick wax coating, they ripen at the end of August. The fruit flesh is golden yellow, dense, juicy, sweet, with a very pleasant taste. The stone is completely separated from the pulp. The fruits are suitable for fresh consumption, for drying, marmalades, jams and for brandy production. The cultivar is very fruitful.

Pestilka is an old cultivar, distributed mainly in Kazanlak. The fruits ripen in late August or early September. They are small-sized, ellipsoid shapes. The skin is thick, and dark blue. The flesh is copper-yellow, juicy, very sweet. The fruits are suitable for processing into marmalades and pestil, hence the name of the cultivar. The cultivar is very fruitful.

Gabrovska. It was obtained by crossing Kjustendilka sinia sliva and Montfort plum in 1951 at the Plum Experimental Station in Dryanovo by Prof. M. Vitanov and Senior Research Associate P. Marinov. In 1971 was established as a variety.

According to the author, the tree is moderately to vigorously growing. The crown is wide pyramidal with evenly distributed skeletal branches. Skeletal branches are thin and come out at a great angle. They are evenly garnished with short fruitwood. Blossoming is medium early. The cultivar is self-sterile. Good pollinators are cultivars, such as Stanley, Strinava and Althan's Gage.

The fruits ripen in the first ten days of August. They are large with an average weight of 32 g, oval, flattened on the sides, and symmetrical. Fruit skin is dark blue, with a thick wax coating. The fruit flesh is light yellowish-brown, tender, dense, juicy, and sweet, with a pleasant acid, with excellent taste qualities. The cultivar is very fertile, the average yield from one tree is about 80 kg.

It is tolerant to sharka (Plum pox virus), early and late brown rot, rust, and slightly susceptible to red leaf spot. At low relative air humidity at the beginning of July, the fruits fall prematurely (Vitanova et al., 2006).

Strinava. The cultivar was obtained from a crossing of 'Kjustendilka sinia sliva' × Montfort in 1957 at the Plum Experimental Station in Dryanovo by Prof. M. Vitanov and Senior Research Associate P. Marinov. In 1974, it was established as a cultivar.

The tree is moderately growing and forms a dense globose crown. Blossoming is medium early. The cultivar is self-fertile. Strinava is a very common cultivar, the average yield per tree is 75 kg.

The fruits ripen in the third ten days of August. They are large with an average weight of 30 g, with an inverted egg shape. The skin is dark violet-blue, with a thick wax coating. The flesh of the fruit is yellowish orange, dense, juicy, and very sweet, with a pleasant aroma and a separable stone. It is considered tolerant to sharka (Plum pox virus). Tolerant to

early brown rot and red leaf spots. It is moderately susceptible to blossom blight.

Phenology of blossoming

Heirloom local cultivars are self-fertile and do not need pollinators. Of the selected cultivars, Gabrovska is self-sterile and good pollinators for it are Stanley, Strinava and Althan's Gage.

Table 1 shows that the earliest blossoming began in 2019, at the end of March for Drebnaya byala rakiinica, and ended for all cultivars on 13–15.04.2019, as the latest blossoming began and ended for Stanley (02.04.–16.04.2019). A characteristic feature for 2021, a later blossoming was noted for the study period, but again Drebnaya byala rakiinica started blossoming the earliest (10.04.2021), whereas Strinava was the latest (14.04.). The end of blossoming in 2021 was between 22.04 (Drebnaya byala rakiinica) and 28.04. (Stanley).

The difference between the heirloom local cultivars and Stanley, for the beginning of blossoming is about 5 days, and in terms of ripening about 20 days. Under the growing conditions in the Fore-Balkan region, there is no risk of late spring frosts, so the risk of damage during blossoming is minimal.

The ripening period of the local plum cultivars is at the beginning of August. Drebnaya byala rakiinica and Byala razgradska ripen by August 15, and Gabrovska, Strinava, and Stanley in this sequence in the second half of August (Table 1). This allows for uniform labor employment for harvesting, and the fruit production is processed in a timely manner.

According to the fruit size of the four studied cultivars, Pestilka and Drebnaya byala rakiinica are defined as very small-sized, weighing less than 15 g, Sakarka and Byala razgradska belong to the small-sized fruit group, weighing up to 20 g (Nedev et al., 1979). The values of this indicator are presented in Table 2. The average fruit weight for the period ranged from 6.81 g for Drebnaya byala rakiinica to 19.92 g for Byala razgradska in 2019, then the fruits of local cultivars had the largest matter. In 2020 and 2021, Drebnaya byala rakiinica has significantly small-sized fruits (5 g).

Table 1. Phenological calendar (2019–2021)

Cultivar	Beginning of blossoming			Full blossoming			End of blossoming			Fruit ripening average
	2019	2020	2021	2019	2020	2021	2019	2020	2021	
Pestilka	28.03	08.04	13.04	29.03	09.04	15.04	13.04	21.04	27.04	8–15.08.
Sakarka	28.03	07.04	11.04	29.03	08.04	12.04	13.04	20.04	24.04	10–16.08
Byala razgradska	28.03	10.04	11.04	29.03	11.04	12.04	13.04	22.04.	24.04	06–14.08
Drebnaya byala rakiinica	27.03	06.04	10.04	28.03	07.04	11.04.	13.04	19.04	22.04	01–06.08
Gabrovska	02.04	09.04	13.04	03.04	10.04	15.04	15.04	22.04		11–14.08
Strinava	01.04	09.04	14.04	03.04	10.04	15.04	15.04	22.04	27.04	13–16.08
Stanley	02.04	12.04	13.04	04.04	13.04	15.04	16.04	24.04	28.04.	24–28.08

Table 2. Average weight of fruit and fruit stone in plum cultivars (2019–2021)

Cultivar	Fruit weight, g			Stone weight, g		
	2019	2020	2021	2019	2020	2021
Pestilka	14.36±0.68	12.33±0.36	12.79±0.33	1.14±0.42	0.70±0.03	0.76±0.02
Sakarka	18.03±0.29	17.28±0.23	16.27±0.18	0.9±0.03	0.67±0.02	0.84±0.03
Byala razgradska	19.92±0.24	16.68±0.46	19.1±0.25	0.89±0.04	0.86±0.02	0.93±0.01
Drebna byala rakiinica	6.81±0.33	5.31±0.12	5.10±0.14	0.51±0.04	0.45±0.03	0.44±0.02
Gabrovska	27.78±1.11	24.16±0.88	28.61±0.93	0.84±0.03	1.1±0.04	0.94±0.42
Strinava	31.17±0.89	23.97±0.46	28.34±1.17	1.03±0.04	1.09±0.03	1.45±0.02
Stanley	39.52±2.69	30.54±0.71	36.47±2.46	1.73±0.05	1.7±0.05	1.86±0.11
LSD 0.05	3.65	1.49	3.13	0.47	0.11	0.15

Ivanova et al. (2015) define Byala razgradska as a fruitful and annually fruit-bearing cultivar. Fruits are attractive in appearance with an average weight of 25.8 g, average height of 41.8 mm, average width of 27.4 and thickness of 29.7 mm. The fruit skin is thin, tough, tender, dark yellow to amber-yellow colored. The fruit stone is separated from the fruit flesh and its percentage weight is 4.2% of the fruit weight, which is greater than that of Stanley – 3.3%. The average yield per tree was 65.8 kg over the period of their study (2011–2014).

For the period of the present research (2019–2021), Byala razgradska cultivar had an average weight of 19–20 g, but the biometric measurements were the highest: the fruit height was 42 mm, 30 mm wide and 36 mm thick. This defines them as the largest in 2019, similar to Gabrovska, Strinava and the standard Stanley cultivar. In all cultivars, for each subsequent year, the fruits decreased in size, as they were the smallest in 2020 (Table 3). This is probably due to the lack of fertilizing and better care, as well as the greater age of the trees, but the yield remained stable.

Stone weight is an important pomological trait genetically determined for each cultivar and is not significantly influenced by agroecological conditions. For the cultivars in the

present study, it varied between 0.90–1.14 (g) for local and selected cultivars, and 1.70 (g) for Stanley (Table 2).

The yields of the cultivars with white fruits, such as Byala razgradska and Drebna byala rakiinica, are the highest (average 115–120 kg per tree), followed by Sakarka and Pestilka (92, 97 kg/tree), as the selected cultivars Gabrovska and Strinava had an average yield of 75–80 kg per a tree. The Stanley cultivar produced an average of about 50 kg of fruit per tree (Table 4).

Dry matter content (Table 4) is at its highest in 2021, with Strinava leading (22%), followed by Byala razgradska

Table 4. Yield per tree, Dry matter content in fresh fruit

Cultivars	Yield per tree, kg average for the period (2019–2021)	Dry matter, %		
		2019	2020	2021
Pestilka	97	15.2	16.2	17.2
Sakarka	92	18.4	17.5	18.2
Byala razgradska	115	14.8	17.4	18.5
Drebna byala rakiinica	120	22.2	20.0	21.4
Gabrovska	80	16.7	18.0	18.5
Strinava	75	19.9	19.1	22.1
Stanley	48	17.3	19.1	21.34

Table 3. Fruit size (2019–2021)

Cultivar	Height, mm x±Sx			Diameter, mm x±Sx			Thickness, mm x±Sx		
	2019	2020	2021	2019	2020	2021	2019	2020	2021
Pestilka	37.72±0.44	30.90±0.80	30.54±0.57	27.15±0.22	25.95±0.36	54.44±0.71	25.86±0.33	26.18±0.44	24.72±0.22
Sakarka	34.8±1.27	33.97±0.65	31.16±0.51	30.06±0.50	24.54±0.28	22.84±0.62	28.5±0.45	26.04±0.53	25.3±0.62
Byala razgradska	42.56±0.60	40.89±0.60	39.98±0.87	34.49±0.40	29.31±0.31	27.28±0.70	36.41±0.59	31.89±0.47	30.72±0.77
Drebna byala rakiinica	25.76±0.61	23.25±0.36	21.68±0.45	22.0±0.54	20.47±0.36	20.84±0.50	21.86±0.43	14.49±0.34	19.86±0.42
Gabrovska	41.73±0.60	37.78±0.66	41.73±0.60	33.63±0.59	29.6±0.56	33.65±0.59	33.32±0.62	28±0.42	33.32±0.62
Strinava	42.86±0.74	38.0±0.39	40.08±1.23	33.01±0.66	31.0±0.84	36.02±0.62	34.71±0.40	33.34±0.48	33.17±0.72
Stanley	44.92±1.11	43.41±0.78	44.85±1.07	35.19±0.64	34.76±0.43	36.12±0.87	35.32±0.71	33.33±0.51	36.33±0.77
LSD (0.05)	2.39	1.79	2.03	1.54	1.79	1.51	1.52	1.32	1.52

and Stanley (21%). The lowest dry matter content in 2021 was registered for Pestilka (17.2%), which in previous years reached only 16.2% for 2020 and 15.2% for 2019. For the entire period of the study, the least amount of dry matter was reported for Byala razgradska in 2019 (14.8%). This is due to the watery structure of the pulp. Ivanova et al. (2009) reported a dry matter of Drebna bqla rakinica 18.12%.

Technological suitability

Drebna byala rakiinica with a yellow colored fruit skin, due to its high fruitfulness and high content of dry matter, is extremely suitable for drying and distillation with a high yield.

Since the the fruit flesh and skin of Byala Razgradska are light-coloured and the fruit is larger, it is suitable for fresh consumption and the production of jams.

Pestilka and Sakarka are suitable for drying in different types of dryers, because of their dark fruit color, moreover the fruit stone of Sakarka completely separates the stone and has a small randeman (4.3%). They have excellent taste qualities, similar to the Kyustendilska cultivar. They are also suitable for jams and marmalades, because after processing they remain black and do not turn red, which is a preferred characteristic of the consumer's taste.

The Gabrovska cultivar, as a relative of Kyustendilska, brings its excellent taste qualities, which makes it suitable for fresh consumption and especially for jams and marmalades.

The fruits of Strinava are suitable for fresh consumption and processing in all directions. It is not recommended for drying because the fruit skin is reddish and after drying is not accepted by consumers.

Susceptibility to diseases

Pestilka and Sakarka have clearly expressed symptoms on the leaves and weak to no symptoms on the fruits. Therefore, they are defined as tolerant to the Plum-pox virus. Such are the selected cultivars Gabrovska and Strinava. Byala Razgradska shows field resistance to the virus. The symptoms on the fruits of Byala Razgradska, Pestilka and Sakarka are in the form of barely noticeable surface spots and drawings. They do not drop prematurely and are suitable for consumption and processing. The symptoms are slightly pronounced and rarely manifested in Byala Razgradska (Stefanova et al., 2016)

The studied cultivars have field resistance to early and late brown rot and rust, they are slightly susceptible to red leaf spot and do not significantly affect fruit quality and yield.

Conclusions

The studied plum cultivars from the local gene pool and the selection of Plum Experimental Station in Dryanovo possess valuable biological and economic qualities, such as high fruitfulness, superior taste qualities, high dry matter content and different fruit ripening periods, which is a valuable biological diversity and deserves to be preserved and used.

The blossoming took place at the end of March, the beginning of April, without any risks of critical temperature drops, for about 12-15 days, which is enough time for pollination and fertilization. The ripening period of the local plum cultivars was at the beginning of August, whereas the selected cultivars, such as Gabrovska, Strinava and Stanley ripened in the second half of August.

According to the fruit size of the four studied cultivars, Pestilka and Drebna byala rakiinica are defined as very small-sized, with a weight less than 15 g, Sakarka and Byala Razgradska belong to the group of small fruits with a weight of up to 20 g. Gabrovska and Strinava are large-fruited (on average 28 g), compared to the standard Stanley cultivar – 38 g.

The described plum cultivars, due to their good taste qualities, similar to the Kyustendilska cultivar, are suitable for fresh consumption, drying in various types of dryers, and processing into jam, marmalades, and distillates.

The assessment was made in a typical plum-producing area, with the characteristic soil, climate and agroecological conditions. The cultivars are well adapted to these conditions and do not need expensive agrotechnical and plant protection measures, the yields remain stable for a long period of time, and the biological potential is fully expressed.

The results of this research give us reason to recommend the local and selected cultivars for wider distribution, to enrich the cultivar assortment and to include them in intensive and sustainable orchards.

Translator's note: the following cultivars are transliterated: Byala Razgradska (which means White plum from the region of Razgrad), Drebna byala rakiinica (Small white plum for making rakia)

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