

UDC: 634.22-152.7(497.2)  
ID: 195736588  
Review paper

*Acta Agriculturae Serbica, Vol. XVII, 33 (2012) 3-11*



## **Major results of plum breeding in Bulgaria**

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**Abstract:** For a long time plum has been and it is still the major structure-forming crop among the fruit species in Bulgaria. Many local cultivars were grown in the past, a large number of them belonging to the cultivar type 'Kyustendilska sinya sliva'. That is why breeding of new plum cultivars has been carried out in many research institutions in the country. The first organized plum breeding programmes started in 1950 at the Plum Experimental Station in the town of Dryanovo and at the Faculty of Agronomy within the University in Plovdiv. A little later, in 1953, plum breeding activities started at the institutes in Troyan, Kyustendil and Kostinbrod, all of them affiliated to the Agricultural Academy – Sofia. The plum breeding programme of the Fruit-Growing Institute in Plovdiv is comparatively new, starting in 1987. All the old and new breeding programmes have a common goal – the development of plum cultivars resistant to Sharka virus disease /PPV/. In the frames of all the programmes, 29 plum cultivars have been established in Bulgaria, the most widely distributed in industrial plantations being 'Gabrovska', 'Strinava', 'Gulyaeva', 'Nevena', 'Balvanska slava', 'Baleva sliva', 'Osogovska edra', 'Plovdivska' and

‘Izobilie’. The paper presents a summarized analysis of the achievements of plum breeding in Bulgaria.

The merits of all the breeders, whose creative research has directly or partially led to the establishment of new cultivars, are pointed out. Statistical data on all the plum cultivars established during the 60-year period since the middle of the last century until present, are published. An analysis is made on the efficiency of the used parent cultivars.

**Key Words:** plum, *Prunus domestica* L., breeding, cultivars

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### Brief History of Plum Production

Plum has been grown on the Bulgarian lands ever since the remote past. It was a species known to the old Greeks, later to the Romans and still later to the Slavs. Until World War II and a long time after it the fruit orchards in Bulgaria were mainly planted with plum trees. At the end of 19 c. and the beginning of 20 c. plum occupied 60% of the fruit plantations. In the middle of 20 c. the plum orchards were 50% of the fruit planted areas and in 1955 the relative share of plum orchards was 36%. The maximum area of 53700 ha occupied with plum orchards was reached in 1964. In the next ten-year period the areas decreased every year and in 1975 they dropped down to 28570 ha, representing a relative share of 20% of the fruit orchards in Bulgaria (Iliev *et al.*, 1977). The monocultivar production developed in result of the mass growing of ‘Kyustendilska’ cultivar, susceptible to PPV, and the lack of fast and good quality diagnostics for control of the virus infections in the planting material, were the major reasons for the rapid decline of plum production in Bulgaria after 1971 (Kitanov 1986; Iliev *et al.*, 1999; Stoev 2007).

After 1990 political and economic changes took place in the country and the land property was restored to the former owners. In result of land fragmentation, a new tendency to a decrease of areas and a decline of production was clearly outlined. Signs of stabilization and modernization of plum production were noted only at the beginning of the present century. Nowadays plum orchards occupy an area of 7489 ha, representing 19% of all the fruit plantations.

Under the conditions of the new restructuring of fruit-growing in Bulgaria, plum continued to be among the priority crops, providing rapid return on investment necessary for establishing and growing the plantations (Zhivondov and Manolova 2004).

### History of Breeding

For a long period of time, covering the whole 19 c. and probably before that, till the middle of 20 c., a large group of local plum cultivars were grown on the lands of Bulgaria. They were all obtained as a result of artificial selection realized purposefully by the population, nowadays categorized as ‘folk breeding’. On principle, most of those old cultivars have primitive pomological characteristics and

they have not been officially registered by any state institution. The local population from different regions of Bulgaria preferred to grow separate smaller groups of those local cultivars, for which it had been established to develop best and bear fruits under the soil and climatic conditions of the concrete region or microregion. That is the reason why many of the old cultivars were named after the settlement where their growing was concentrated. Others were named after the use of their fruit. More popular old cultivars are 'Byala rakiynitsa', 'Sakarka', 'Medenka', 'Sinakvitsa', 'Byala Razgradska', 'Zaeshka', 'Sinya rakiynitsa', 'Pestilka', 'Duninka', 'Babini Marinkini', 'Favoritka na sultana', 'Zhalta butilkovidna', 'Zhalta ablanshka', 'Bereketliyka', 'Lyatna trankosliva from Elena', 'Lyatna trankosliva from Gabrovo', 'Manastirka', 'Bardachka', 'Zaharna', 'Karadzheyka', 'Kraslanka', 'Byala uhrepka', 'Le-sidryanska', 'Topalka', 'Debelyacha', 'Tetevyanka', 'Berovka', 'Belvitsa', 'Malva-zinka', 'Priboyka', 'Zhatvarka', 'Karpuzlia', etc. (Balev 1958, Stoichkov *et al.*, 1960, Ivanova 2006).

Most of the local cultivars belong to the botanical subspecies *Prunus domestica* L. *subsp. domestica* and only a small share of them belong to the subspecies *P. domestica* L. *subsp. insititia*. At present they are grown on a limited scale only in private house yards and in collection plantations of the research institutions in Dryanovo, Troyan, Plovdiv and Kyustendil.

The local plum cultivars practically show high level of resistance to biotic and abiotic factors, which explains their survival during the long period of their existence. Most of them were propagated by suckers and it was only at the middle of the last century when their propagation by grafting started. A small share of the old cultivars was also propagated by seeds by the local inhabitants and in that way the reproduction of the pomological characteristics of the mother trees was achieved quite successfully. Thus more homogenous populations were obtained in separate microregions. After applying virus screening, some of the cultivars have been determined as tolerant to Plum pox virus. Those are the cultivars 'Byala rakiynitsa', 'Byala Razgradska', 'Sinya rakiynitsa', 'Tarkulka', 'Pestilka', etc. They were successfully used in the breeding programmes for establishing new plum cultivars.

Most of the local plum cultivars are highly productive. 60-70 kg of fruit per tree is obtained in average and the yield from a hectare could reach up to 20-25 tons of fruit. Fruits of most local cultivars are small – about 15 g, which makes them very suitable for drying. They have a high content of dry matter – 21-230 Brix, they have sweet taste, a pleasant aroma and some of them – pleasant acidity. They are suitable to be processed into marmalade, jelly, rakia/brandy, etc. (Ivanova 2006, Ivanova *et al.*, 2009).

The local cultivar 'Kyustendilska sinya' has a great advantage over all the old Bulgarian cultivars because of its large historical spread. In contrast to all the other old plum cultivars of local distribution, 'Kyustendilska sinya' cv. has been widely grown all over the country. That provided the opportunity to the local

inhabitants from different regions to use it in the so-called 'folk breeding', in result of which a large number of local clones, forming local populations, have been selected. Those populations, of course, are a part of the general population of 'Kyustendilska sinja' that has been formed for centuries in Bulgaria. Similar cultivar types (populations) have been permanently spread in many other European countries known under different local names.

According to Iliev *et al.* (1977) and Hartmann and Neumuller (2009), the cultivar types 'Prune d'Agen' and 'German Prune' are the most widely spread in Europe and they are called 'Hauszwetsche' in Germany, 'Pozegaca' – in the Western Balkan countries, 'Besztercei' – in Hungary, 'Casalinga' and 'Dro-Zwetsche' – in Italy, 'Quetsche Communa' – in France, 'Vinete Romanesti' – in Romania and 'Kyu-stendilska' – in Bulgaria. According to the same authors, those plum types are also known as 'common plum' in some countries.

All the mentioned plum cultivar types belong to the 'prunes' category and they are representatives of the botanical subspecies *Prunus domestica* L. *subsp. domestica*.

### Results of the Breeding Programmes

The beginning of the organized plum breeding in Bulgaria was laid in the middle of the last century when the available foreign cultivars were quite few, among them 'Montfort', 'Anna Spath', 'Italian Prune', 'Tuleu gras', 'Prune d'Agen', 'Reine Claude violette', 'Green gage', 'Bonne de Louven', 'Ontario', 'Buhler Fru-hzwetsche'. At the very beginning of implementing the breeding programmes, the major aim was the establishment of new plum cultivars resistant to PPV and other diseases and possessing fruit qualities like 'Kyustendilska'. Later, some additional breeding aims have been set, such as different periods of ripening, large size of the fruits, possibility of mechanized fruit harvesting.

At the beginning of plum breeding activities in the Plum Experimental Station in Dryanovo and in the Institutes in Troyan and Kyustendil, a selection among the population of 'Kyustendilska' plum type was carried out, in result of which large-fruited forms, resistant to diseases, were chosen. Later they were used in the hybridization programmes by crossing them with some of the cultivars imported from abroad. Some better clones of 'Kyustendilska' that gained popularity in Bulgaria, are: D-4, D-5 and D-6 – selected in Dryanovo and the clones 'Troyanska sinja' 2-24, T-32 and 'Ostreshka' – selected in Troyan (Balev 1958; Iliev *et al.*, 1985).

The first plum breeding programmes started in 1950 at the Plum Experimental Station in the town of Dryanovo and at the Faculty of Agronomy within the University in Plovdiv. A little later, in 1953, plum breeding activities started also at the Research Institute of Mountain Stockbreeding and Agriculture in Troyan, at the Institute of Agriculture in Kyustendil, at the Agricultural Academy –

Sofia and at the Plant Protection Institute in Kostinbrod (Balev 1958; Iliev *et al.*, 1977).

Tab. 1. Bulgarian plum cultivars established in the frames of the breeding programmes in Dryanovo, Troyan, Kyustendil, Sofia and Plovdiv

| No. | Cultivars                      | Parent Combinations                                          | Place of establishment | Year of recognition | Authors                                      |
|-----|--------------------------------|--------------------------------------------------------------|------------------------|---------------------|----------------------------------------------|
| 1.  | Dryanovska                     | Kyustendilska x Sakarka                                      | Dryanovo               | 1962                | Petko Marinov and Marko Vitanov              |
| 2.  | Sinya Yubileyna                | Kyustendilska x Montfort                                     | Dryanovo               | 1962                | Petko Marinov and Marko Vitanov              |
| 3.  | Gulyaeva                       | Kyustendilska x Monfort                                      | Dryanovo               | 1964                | Marko Vitanov and Petko Marinov              |
| 4.  | Gabrovska                      | Kyustendilska x Monfort                                      | Dryanovo               | 1971                | Marko Vitanov and Petko Marinov              |
| 5.  | Pop Hariton                    | (Kyustendilska x Bonne de Louven) x Italian Prune            | Dryanovo               | 1971                | Marko Vitanov and Petko Marinov              |
| 6.  | Burya                          | Kyustendilska x Monfort                                      | Dryanovo               | 1972                | Petko Marinov and Marko Vitanov              |
| 7.  | Strinava                       | Kyustendilska x Monfort                                      | Dryanovo               | 1974                | Petko Marinov and Marko Vitanov              |
| 8.  | Nevena                         | Kyustendilska x Altan's gage                                 | Dryanovo               | 1984                | Marko Vitanov                                |
| 9.  | Vitanova                       | Kyustendilska x Anna Spath                                   | Dryanovo               | 1988                | Marko Vitanov                                |
| 10. | Balvanska Slava                | Stanley x Pop Hariton                                        | Dryanovo               | 1994                | Marko Vitanov                                |
| 11. | Kasnotsaftashta<br>sinya sliva | Lesidryanska x Bonne de Louven                               | Troyan                 | 1978                | Micho Balev                                  |
| 12. | Ranna sinya                    | Tetevyanka x Zaharna                                         | Troyan                 | 1979                | Micho Balev                                  |
| 13. | Edra trankosliva               | <i>Prunus spinosa</i> x <i>Prunus domestica</i> 'Green gage' | Troyan                 | 1996                | Micho Balev and Ivan Minev                   |
| 14. | Baleva sliva                   | (Kyustendilska x Bonne de Louven) x Malvazinka               | Troyan                 | 1997                | Micho Balev and Ivan Minev                   |
| 15. | Strumska sinya                 | Kyustendilska x Monfort                                      | Kyustendil             | 1961                | Anastas Enev and Boyan Videnov               |
| 16. | Osogovska edra                 | Zhatvarka – o.p.                                             | Kyustendil             | 1961                | Anastas Enev and Boyan Videnov               |
| 17. | Kyustendilska<br>ranna         | Kyustendilska x Monfort                                      | Kyustendil             | 1963                | Anastas Enev and Boyan Videnov               |
| 18. | Izobilie                       | Kyustendilska x Monfort                                      | Kyustendil             | 1972                | Anastas Enev and Boyan Videnov               |
| 19. | Kyustendilska<br>krasavitsa    | Kyustendilska – o.p.                                         | Kyustendil             | 1992                | Vasil Georgiev                               |
| 20. | Sofiysko chudo                 | Unknown                                                      | Sofia                  | 1967                | Alexander Hristov                            |
| 21. | Septemvriyska                  | Ranna sinya – o.p.                                           | Sofia                  | 1968                | Alexander Hristov                            |
| 22. | Sofia 2                        | Ranna sinya x Monfort                                        | Sofia                  | 1972                | Alexander Hristov                            |
| 23. | Serdika 2                      | Ranna sinya x Bonne de Louven                                | Sofia                  | 1974                | Alexander Hristov                            |
| 24. | Plovdivska                     | Kyustendilska x Monfort                                      | Plovdiv                | 1964                | Velko Velkov                                 |
| 25. | Pulpudeva                      | Unknown                                                      | Plovdiv                | 1972                | Ivan Iliev, Vetka Drensk and Todor Zhivondov |
| 26. | Plovdivska<br>renkloda         | Stanley – o.p.                                               | Plovdiv                | 2009                | Argir Zhivondov                              |
| 27. | Sineva                         | Stanley – o.p.                                               | Plovdiv                | 2009                | Argir Zhivondov and Valentina Bozhkova       |
| 28. | Ulpia                          | President – o.p.                                             | Plovdiv                | 2009                | Argir Zhivondov and Valentina Bozhkova       |
| 29. | Ostromila                      | Pacific x Serdika 2                                          | Plovdiv                | under procedure     | Argir Zhivondov and Snezhana Milusheva       |

The largest-scale breeding activities on plum were carried out in Dryanovo. A rich hybrid fund was established, from which 10 cultivars were bred and officially recognized in Bulgaria. In the 60s of the last century, the cultivars 'Dryanovska', 'Sinya yubileyna' and 'Gulyaeva' were registered, followed in the next decade by the cultivars 'Gabrovska', 'Pop Hariton', 'Burya' and 'Strinava', and in the 80s – by 'Vitanova' and 'Nevena'. The latest cultivar established in Dryanovo is 'Balvanska slava', registered in 1994 (Table 1). More widely spread in the industrial-scale plantations in Bulgaria are the cultivars 'Gabrovska', 'Strinava' and 'Gulyaeva', established by Prof. Marko Vitanov and Prof. Petko Marinov, as well as the cultivars 'Nevena' and 'Balvanska slava', bred by Prof. Vitanov. Hybridization with the participation of the parent cultivars 'Kyustendilska', 'Montfort', 'Stanley' and 'Altan's gage' proved to be the most successful.

In parallel with the direct breeding activities in Dryanovo, a number of studies have also been carried out on the mechanism of inheriting different levels of resistance to the diseases Plum Pox virus, *Polystigma rubrum*, *Tranzschelia pruni spinosae* and *Monilinia laxa*. Genes controlling the way of inheriting the resistance have been found out, as well as possibilities of their recombining with donors of desired pomological characteristics of the fruits (Vitanov 1977).

The programme on breeding plum cultivars in Troyan was initiated by Assoc. Prof. Micho Balev. A rich hybrid fund was established, comprising over 8000 hybrid plants obtained by intra- and interspecific controlled sexual hybridization. Four plum cultivars were obtained, the first one being 'Ranna sinia sliva', which was officially recognized in 1979. The cultivar was obtained from the old local cultivars 'Tetevyanka' x 'Zaharna'. The cultivar 'Kasnotsavtyashta sinia sliva' was established by crossing 'Lesidryanska' x 'Bonne de Louven' cvs. The cultivar 'Edra trankosлива' was established by interspecific hybridization (*Prunus spinosa* x *Prunus domestica* 'Green gage') and it was officially recognized in 1996. The latest cultivar established in Troyan is 'Baleva sliva', obtained from the second hybrid progeny of the parent combination ('Kyustendilska' x 'Bonne de Louven') x 'Malvazinka' (Minev 1997, 2000, Minev and Balev 2000, 2002).

Five plum cultivars were established at the Institute of Agriculture in Kyustendil, among them the cultivars 'Kyustendilska ranna', 'Strumska sinia' and 'Izobilie', originating from the parent combination 'Kyustendilska' x 'Montfort'. The cultivar 'Osogovska edra', officially recognized in 1961, was selected from a population obtained by open pollination of the local cultivar 'Zhatvarka'. Those four cultivars were a result of the efforts of the breeders Anastas Enev and Boyan Videnov. The latest cultivar 'Kyustendilska krasavitsa' was established by Prof. V. Georgiev and it was recognized in 1992. It was obtained from a population established by open pollination of the cultivar 'Kyustendilska' (Iliev *et al.*, 1977, 1985).

In the 70s of the last century at the Plant Protection Institute affiliated to the Agricultural Academy – Sofia, Prof. Aleksandar Hristov established the plum cultivars ‘Septemvriyska’, ‘Sofiysko chudo’, ‘Sofia 2’ and ‘Serdika 2’, characterized by their high resistance to PPV. In his breeding activities the author used the parent cultivars ‘Sinya ranna’, ‘Montfort’ and ‘Bonne de Louven’ (Iliev *et al.*, 1977; 1985).

In 1964 the cultivar ‘Plovdivska’ was registered, which was established at the Department of Fruit-Growing within the Agricultural University – Plovdiv by Prof. Velko Velkov and the cultivar ‘Pulpudeva’ was developed in 1972 at the Fruit-Growing Institute in Plovdiv (Iliev *et al.*, 1985).

The plum breeding programme of the Fruit-Growing Institute in Plovdiv is comparatively new, starting in 1987 with the same major breeding aim set – the establishment of cultivars resistant or tolerant to Plum pox virus and bearing fruits of a better sensory profile, suitable for drying or fresh consumption. The hybrid fund, compiled for more than 20 years and comprising almost 4000 plants, includes 45 populations, 35 of them originating from controlled hybridization. Over 90 elites were selected, only one of them belonging to *Prunus salicina* species and all the others – to *Prunus domestica* species (Zhivondov 1994, Zhivondov and Djouvinov 2002).

In relation with the permanent updating of the breeding programme, an analysis was made, as a result of which the plum cultivars most often used in breeding as donors of specific characteristics, were determined (Bozhova and Zhivondov 2004). The first successfully finalized products of the breeding programme realized at the Fruit-Growing Institute, were obtained in 2009, when three new plum cultivars were officially recognized – ‘Plovdivska renkloda’, ‘Sineva’ and ‘Ulpia’. ‘Plovdivska renkloda’ is the first Bulgarian cultivar of the group of the Reine Claudes. In contrast to all the other cultivars of that group, it is self-fertile. The three new cultivars are tolerant to Sharka virus disease /PPV/, (Zhivondov 2009, Zhivondov 2010, Zhivondov and Bozhkova 2010). The latest Bulgarian cultivar ‘Ostromila’ is in a procedure of state variety testing.

## Conclusions

Data analysis shows that 29 plum cultivars were established in Bulgaria during the 60-year period of developing the breeding programmes. Out of them, 21 cultivars were obtained by controlled hybridization, for 6 cultivars only the mother parent is known and for 2 cultivars the parents are unknown. Most of the newly developed plum cultivars were with the participation of ‘Kyustendilska’, and what is more, always used as a mother parent. 15 cultivars were established in that way. The most efficient proved to be the parent combination ‘Kyustendilska’ x ‘Montfort’, from which 9 plum cultivars were established. Two of the Bulgarian cultivars were obtained from second hybrid generation

(‘Pop Hariton’ and ‘Baleva sliva’) and only the cultivar ‘Edra trankosliva’ was established by interspecific hybridization.

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## **GLAVNI REZULTATI SELEKCIJE ŠLJIVE U BUGARSKOJ**

- pregledni rad -

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### **Rezime**

Šljiva odavno zauzima glavno mesto u voćarskoj strukturi Bugarske. U prethodnom periodu, gajene su mnoge lokalne sorte, koje većinom pripadaju tipu 'Kyustendilska sinya sliva'. Iz tog razloga, u mnogim istraživačkim institucijama u zemlji vrši se selekcija novih sorti šljive. Prvi organizovani programi selekcije šljive pokrenuti su 1950. godine u Eksperimentalnoj stanici za selekciju šljive u gradu Drjanovu i na Agronomskom fakultetu Univerziteta u Plovdivu. Nešto kasnije, 1953. godine, rad na selekciji šljive započet je i na institutima u Trojanu, Čustendilu i Kostinbrodu pri Poljoprivrednoj akademiji u Sofiji. Program selekcije šljive organizovan u okviru Instituta za voćarstvo u Plovdivu relativno je novijeg datuma, budući da je pokrenut 1987. godine. Svi prethodni i novi programi selekcije imaju zajednički cilj – razvoj sorti šljive otpornih na virus šarke. U okviru svih ovih programa, stvoreno je 29 sorti šljiva u Bugarskoj, od kojih su najrasprostranjenije na plantažama sorte 'Gabrovska', 'Strinava', 'Gulyaeva', 'Nevena', 'Balvanska slava', 'Baleva sliva', 'Osogovska edra', 'Plovdivska' i 'Izobilie'. U radu je prikazana sumarna analiza rezultata postignutih u oblasti selekcije šljive u Bugarskoj.

Istaknute su zasluge selekcionara čija su kreativna istraživanja direktno ili delimično doprinela stvaranju novih sorti. Prikazani su statistički podaci o

svim sortama šljive stvorenim tokom 60-godišnjeg perioda od sredine prošlog veka do danas. Izvršena je analiza efikasnosti korišćenih roditeljskih sorti.

**Ključne reči:** šljiva, *Prunus domestica* L., selekcija, sorte