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Breeding programme for developing new sweet cherry cultivars in the Fruit Growing Institute, Plovdiv, Bulgaria

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Abstract. Sweet cherry is a major structural species in Bulgaria. According to the Ministry of Agriculture and Food, in 2010 it occupied 21% of the fruit tree areas, which defined it as a leading fruit crop. It represents 16% of the total fruit production in the country, as is the relative share of peach, being surpassed only by apple and plum production. The increased interest in establishing new cherry plantations necessitates the provision of new market-oriented cultivars with a better sensory profile of the fruits, resistant to biotic and abiotic stress factors, suitable for creating modern intensive cherry plantations. The Bulgarian sweet cherry cultivars are chronologically discussed and a thorough description of the development of the sweet cherry breeding programme, launched at the Fruit Growing Institute in Plovdiv in 1987, is presented. Current objectives comply with the world’s major breeding trends and the changing market requirements. The paper reflects the main objectives of the programme and the finalized products obtained in the last twenty years of the past century and first decade of the new millennium, i.e. the new cultivars ‘Kossara’, ‘Rosita’, ‘Rozalina’ and ‘Thrakiiska hrushtyalka’ and some promising hybrids.

Keywords: Prunus avium, cultivars, hybrids, breeding programme

Introduction

In the period between 1980 and 1990, 156 new cherry cultivars were developed (Bargioni et al., 1998) and in the period 1991 – 2004 the number of new cultivars surpassed 230, 116 of them being created in Europe, 71 in North America and 33 in Asia. According to that statistical data the sweet cherry crop ranks second after peach in number of newly created cultivars (Sansavini and Lugli, 2008). Nowadays it could be stated that in all the countries with well-developed sweet cherry production, active breeding activities are being carried out for creating new sweet cherry cultivars and rootstocks by applying varied breeding methods (Vogel, 1981; Christensen, 1985; Bargioni et al., 1998; Sansavini and Lugli, 2008). The major breeding aims set in the breeding programmes, refer to self-fertility; extending the period of fruit ripening; resistance to Monilinia, Blumeria and Pseudomonas; high and regular fertility; decrease of tree growth vigour; large fruit size; fruit quality improvement, resistance to cracking (Christensen, 1985; Trefois, 1986; Kappel, 2008; Sansavini and Lugli, 2008; Milatović and Nikolić, 2011).


Materials and methods

Breeding Activities for Sweet Cherry Improvement at the Fruit Growing Institute, Plovdiv – creating F1 hybrid generation

The sweet cherry breeding programme of the Fruit Growing Institute (FGI), Plovdiv started in 1987. The major objectives set in the programme at the initial stage were:

- Developing self-fertile cultivars;
- Developing self-fertile cultivars with compact crowns;
- Developing self-fertile, early ripening cultivars bearing large sized fruit.

The cultivars ‘Van’, ‘Stella’, ‘Compact Van’, ‘Compact Stella’, ‘Rivan’ and ‘Sunburst’ were chosen for creating F1 hybrid generation. Other suitable cultivars were additionally included in the programme depending on their supply to the collection of the...
Institute and the results of the carried out studies. The early cultivars 'Bigarreau Burlat', 'Early Chêna', 'Ohio Beauty' and 'Early Rivers' were additionally included in the programme. The cultivars 'Compact Lambert' and 'Starkrimson' cherry participated in the programme for creating self-fertile hybrids with compact tree crowns. The late ripening cultivars 'Germersdorfer', 'Badacsony', 'Ferrovia spur', 'Lapins' and the very late one 'Sweet September' were included in the breeding scheme with the aim of extending the cherry ripening season. Evaluation of the seedlings, selection and propagation of elites started after their entering the fruit-bearing stage, in the period 1996-2000, and the candidate cultivars were nominated after 2000.

**Breeding Activities for Sweet Cherry Improvement at the Fruit Growing Institute, Plovdiv – creating F2 hybrid generation**

The creation of second hybrid generations started within the period 1996-2000 and the process is still continuing. New possibilities for obtaining considerably better results in establishing the cherry hybrid fund at the Fruit-Growing Institute in Plovdiv were also provided by the specific biotechnological decisions for in vitro cultivation, propagation and adapting the cherry embryos of early ripening parent cultivars and forms (Gercheva, 1991; Gercheva and Zhivondov, 2002).

The constant updating of the hybridization programme has necessitated annual changes for its improvement. Until 2012 inclusive, the number of the parent combinations used throughout the years has surpassed 120. Adding new breeding objectives to the programme complies with the market tendencies and the changing consumer preferences.

The strategic aim of the programme was to contribute to the restoration of the competitiveness of Bulgarian fruit-growing by breeding new and introduction of perspective sweet cherry cultivars and rootstocks. Programme implementation has resulted in the establishment and studying new cultivars and rootstocks having market-oriented characteristics, such as:

- early and very early larger-fruited cultivars;
- late cultivars ripening after the usual season;
- cultivars ripening after 'Bigarreau Burlat' and before 'Bing';
- self-fertile cultivars of both intensive red and light fruit colour;
- cultivars having a firm fruit texture, resistant to cracking;
- cultivars and rootstocks resistant to biotic and abiotic stressors;
- cultivars and rootstocks having poor and moderate growth vigour;
- An important activity is the introduction of new and perspective cultivars and rootstocks with the aim of including them in the hybridization programmes.

**Results and discussion**

For 25 years now a rich genetic fund of first generation hybrids and quite a big fund of second generation hybrids has been established. Until 2011 the total number of the hybrids consisted of over 2600 plants of 58 populations, 31 of them obtained as a result of controlled hybridization, 26 populations obtained by open pollination and 1 population comprising seedlings of an unknown origin. A mass selection was made among the hybrids of the uncontrolled populations at the initial stages. After the breeding evaluation performed by stages, 114 elites were selected depending on their period of fruit ripening and, among them, 4 candidate-cultivars were submitted for official testing by the Executive Agency for Variety Testing, Field Inspection and Seed Control (Zhivondov, 1994; Zhivondov et al., 2004; Zhivondov, 2005a; 2008).

The first breeding achievements of the programme for sweet cherry cultivar improvement have already been accomplished. In March 2008 the first sweet cherry cultivar 'Kossara' created at the Fruit-Growing Institute in Plovdiv, was officially registered. It was obtained by the in vitro method – embryorescue, as a result of crossing the early cultivars 'Ranna Chêna' × 'Bigarreau Burlat'. Its fruits ripen very early – 5 – 10 May and practically they mark the beginning of the sweet cherry ripening season in our country. Rendering an account of the early period of ripening, the fruits are very large – 8 g, i.e. as large as those of 'Bigarreau Burlat' cultivar, however 'Kossara' ripens 10 days before the standard. The fruit shape is cordate, dark red, juicy, deep sweet-sour in taste, having dark red juice (Zhivondov and Gercheva, 2009).

'Rosita' and 'Rosalina' are the two new cultivars bearing light-coloured fruit. They were officially registered in February 2009. 'Rosita' was selected from a population obtained by embryorescue from open pollination of 'Bigarreau Burlat'. Its fruits ripen very early – 3 – 4 days after those of 'Kossara' and a week before 'Bigarreau Burlat'. They are very large – 7.5 g, kidney-shaped, light yellow in colour with light red blush covering up to 50% of the fruit surface. Its taste qualities are very good. 'Rosalina' was obtained by conventional breeding from open pollination of 'Van' cultivar. Its fruits ripen about 5 June, i.e. a week before those of 'Van'. They are very large – 9 – 10 g, kidney-shaped, with a very dense texture and an excellent taste. The fruit skin is creamy yellow as a basic colour, mottled with light red blush covering about 60 – 70% of the fruit surface.

The latest cultivar 'Trakiiska hrushtyalka' was selected from a population obtained by open pollination of 'Van' cultivar. Its fruits ripen 3 – 4 days before those of 'Van' and 3 – 4 days after those of 'Rosalina'. In that way, the two new later ripening cultivars partially fill the gap between the ripening periods of 'Bigarreau Burlat', on the one hand, and 'Bing' and 'Van', on the other, which was in fact one of the objectives set in the breeding programme. The fruits of 'Trakiiska hrushtyalka' are very large – about 10 g, kidney-shaped, dark red in colour, very dense in texture, with an excellent taste (Zhivondov et al., 2004; Zhivondov, 2008).

Out of the selected and propagated hybrids, the studies of which are at an advanced stage, the most interesting are:

- Elite 20-31 was selected from a population obtained by open pollination of 'Van'. The ripening period precedes that of the standard 'Bigarreau Burlat' by 6 days and it is a good alternative to 'Nalina' cultivar thanks to its better taste qualities and dark red colour of the fruit flesh, juice and skin;
- Elite 20-77 originates from open pollination of the cultivar 'Starkrimson' Cherry, from which it inherited the typical colour and mottling of the fruit skin. The period of ripening is medium early (8 days before 'Van'). Important advantages are its self-fertility and late flowering period;
- Elite 17-90 was selected from a population obtained by open pollination of 'Van' and its ripening period precedes the new cultivar 'Trakiiska Hrushtyalka' by 1 – 2 days and the standard cultivar 'Van' by 4 – 6 days. The Elite is characterized by very good fertility and very large fruits of over 8 g without irrigation;
- Elite 20-47 was obtained by open pollination of 'Compact Van'. The fruits have excellent taste qualities and an attractive appearance. They ripen 6 days before those of 'Van'. The major characteristics of the elite are: weak growth vigour, compact habit, high and regular fertility and marked frost resistance;
- Elite 28-208 was created as a result of the hybridization
between the late cultivars 'Lambert' and 'Badacsony'. Fruit weight is about 9 g and the fruits ripen 5 days before those of 'Van'. The Elite is frost resistant and the mass flowering is about a week later compared to the group of the late flowering cultivars.

- Elite 28-209 originates from 'Lambert' × 'Badacsony'. It is characterized by a well-defined cordate fruit shape. The average fruit weight is 8.86 g without irrigation, the fruits are dark coloured, with a long pedicel (40 mm) and well-balanced taste.
- Elite 17-37 was selected from a population obtained by open pollination of 'Van'. The fruits are very large – about 9 g without irrigation and they are late ripening– 2 – 3 days after 'Van'.

**Conclusion**

A rich and varied sweet cherry genetic fund has been maintained and investigated in FGI-Plovdiv, which is an advantage for the success of the breeding activities. The breeding characteristics of a number of sweet cherry cultivars and the combinations among them, used in the programme as donors of certain specific characteristics, have been studied and defined. New possibilities for obtaining considerably better results in establishing the cherry hybrid fund were also provided by the specific biotechnological decisions for in vitro cultivation, propagation and adapting the cherry embryos of early ripening parent cultivars and forms. Rich genetic hybrid funds of the first (F1) and second (F2) generations were established. Series of sweet cherry elites have been selected. The first 4 new cultivars ('Kossara', 'Rosita', 'Rosalina' and 'Trakiska hruštyalka') were created and officially registered by EAVTFISC. A large selection of new sweet cherry candidate-cultivars with very good characteristics is available for submitting and official testing. All this is a very good basis for further success of the sweet cherry breeding activities carried out at the Fruit Growing Institute in Plovdiv.

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