

SURSE DE GENE PENTRU ÎMBUNĂTĂȚIREA SORTIMENTULUI DE CIREȘ DIN BELARUS

RESOURCES FOR IMPROVING THE ASSORTMENT OF SWEET CHERRY VARIETIES IN BELARUS

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Abstract

The sweet cherry genetic collection of RUE "Institute of Fruit Growing" is including 273 accessions, which have been studied for the main economic and biological traits. The main features for selection are large-fruited combined with winter hardiness and resistance to cherry leaf spot. After an evaluation of the collection, three large-fruited accessions with tough pulp of the fruit were selected. The Ukrainian early fruit ripening variety 'Annushka' was selected among the introduced cherry varieties. This variety has large fruits of excellent taste and is characterized by high winter hardiness. Two Belarusian promising selections '84-10/98' ('Narodnaya' o.p.) and '94-30/41' ('Vityaz' × 'Aelita') were selected on these grounds. Selection '84-10/98' has a medium and '94-30/41' has late fruit ripening terms.

Cuvinte cheie: colecție, selecții, rezistență la ger, rezistență la boli, soi.

Key words: collection, selections, winter hardiness, disease resistance, cultivar.

1. Introduction

Sweet cherry is a Southern crop by its geographical origin. Weak winter hardiness is the main limiting factor for promotion of this crop to the North. In the middle of the last century E.P. Syubarova has done a lot of work on the acclimatization of cherries in Belarus (Syubarova, 1964). Often the realization of the genetic potential of local varieties is much higher than the introduced ones (Vyshinskaya, 2001; Alyohina, 2012, 2015; Kan'shina, 2004). As result of the implementation of breeding program in Belarus, winter-hardy varieties have been created (Syubarova, 1964; Vyshinskaya, 2000). Belarusian varieties 'Vityaz', 'Gastinec', 'Gronkovaya', 'Krasavitsa', 'Medunitsa', 'Minchanka', 'Naslazhdenie', 'Severnaya', 'Sopernitsa', 'Syubarovskaya' are widespread and included in the country's register of varieties. Russian cvs. 'Iput', 'Ovstuzhenka', 'Tyutchevka' are highly adaptable to Belarusian soil and climatic conditions and are approved for use (Beinya, 2020; Kazlouskaya, 2020). However, the requirements for the quality of the fruit are increasing on modern market conditions. It is very important to combine in one genotype of sweet cherry high quality fruits and resistance to low temperatures in winter, return frosts in spring and lack of moisture in summer, which greatly affect the productivity and longevity of orchards. This makes it necessary to select a new source material to create new varieties with high commercial qualities of fruits.

The use of intensive technologies in fruit growing has led to a significant increase in requirements for sweet cherry varieties. Requires varieties with a fruit weight of at least 7 g, tough pulp, transportable over long distances, winter hardiness and high disease resistance (Kazlouskaya, 2019). The problem remains the weak genetic protection of varieties from biotic and abiotic stressors. The most effective way to control the adaptability of fruit plants, increase the stability of their fruiting and improve the commercial qualities of fruits is breeding (Vyshinskaya, Taranau, 2008).

The creation of highly adaptive varieties of fruit crops, including cherries, is possible using a qualitatively new source with outstanding characteristics (Taranau, Palubiatka, 2017). The accumulation, study, and use of the genetic diversity of fruit plants allows, based on the biological potential of the plant itself, to design varieties of the future. The main principle of replenishment of the genetic collection is the presence of valuable economic and biological traits or their complex, the use of which have to improve the fruit crop assortment (Kazlouskaya, 2009). One of the most reliable ways to create varieties is hybridization using donors and sources of valuable traits identified as a result of studying the genetic collections. Fruit plant collections are a bank for preserving genetic diversity, the most important source of traits and properties for breeding. For practical breeding work, it is very important to form characteristic collections that can significantly reduce the cost of breeding new varieties. In the period from 1997 to 2020, the collection of cherries was expanded from 24 to 273 accessions. Currently, the genotypes of the collection include species and their derivatives: *P. avium* - 237, *P. cerasus* × *maackii* - 10, *P. mahaleb* L. - 7, *P. maackii* × *cerasus* - 6, *P. cerasus* × *subhirtella* - 2, *P. cerasus* × *canescens* - 1, *P. cerasus* × *lannesiana* No. 2 - 1, *P. cerasus* × *maximoviczii* - 1, *P. dawycensis* S. - 1, *P. fruticosa* × *lannesiana* - 1, *P. fruticosa* × *maackii* - 1, *P. lannesiana* Carr. - 1, *P. lannesiana* × *avium* - 1, *P. serulata* Lindl. - 1, *P.*

serulata × *avium* – 1, *P. serulata* × *cerasus* – 1 (Kazlouskaya, 2019). The geographical origin of these accessions is wide and is represented by the following countries: Belarus - 112, Russia - 89, Ukraine - 30, Canada - 11, Romania - 6, Germany - 4, Italy - 4, Latvia - 4, Sweden - 3, Czech Republic - 2, Belgium - 1, Europe - 1, France - 1, Great Britain - 1, Lithuania - 1, Turkey - 1, USA - 1.

The aim of the research is to evaluate and identify new accessions that have the best economically valuable characteristics (winter hardiness, disease resistance, and fruit quality), the use of which in breeding will allow creating new competitive varieties with high commercial and consumer quality fruits.

2. Material and methods

The research was conducted in 2018-2020 period. The object of the study was the cherry collection from the Institute for Fruit Growing, Belarus (RUE), planted during 2009-2015, which includes 273 varieties and selections of various ecological and geographical origins. Each form is represented by 3-10 trees grafted on the seed rootstock of wild cherry. Tree planting scheme was 5 × 3 m. The soil maintenance in inter-row spacing was sward, in rows-herbicide fallow. Treatments to prevent diseases and pests were made every year. Pruning of trees was made according to spaced tiered system. The main economical and biological value study was carried out according to "Genetic Basis and Methods of Selection of Fruit Crops and Grapes" (Kazlouskaya, 2019).

3. Results and discussions

Assessment for large-fruited

Now the main focus in sweet cherry breeding is on the development of large-fruited new cvs. This feature becomes the main one in the market of fruit products in Belarus. It's known that the fruit size is mainly determined by the genetic characteristics and hereditary properties of the cv., but it can vary depending on the load of the crop and the level of agricultural technology. The traits large-fruited, high taste qualities, tough pulp, fruit size and weight are controlled by recessive genes and this should be taken into account when selecting parental pairs during crosses. A positive effect on the increase in the size of fruit was found when using cvs. with a fruit mass above 7.0 g as female genitors. An involvement of small-fruited cvs. in hybridization significantly reduces the appearance of new large-fruited descendants in the hybrid population (Ryabov and Ryabova, 1975).

In our collection a group of large-fruited cherry cvs. is represented quite widely and serves as the main material used in breeding programs. A group of 44 accessions with large fruits (6.3-8.3 g) was selected in the collection. These are varieties and hybrids of the Belarusian selection: 'Gastinets', 'Maria', 'Minchanka', 'Krasavitsa', 'Naslazhdenie', 'Sopernitsa', '2001-1/23', '2001-1/79', '84-10/97', '86-11/31', '86-15/112', '86-15/126', '04-15/25', '98-3/20', '96-30/86', '89-17/58', '2004-15/8', '86-15/126' and also foreign breeding: 'Aborigenka', 'Butnera krasnaya', 'Valery Chkalov', 'Dar Mlieva', 'Donetskaya krasavitsa', 'Donchanka, Mlievskaya Chyornaya', 'Nezhnost', 'Nektarnaya', 'Otrada', 'Rosovaya kaplya', 'Sadko', 'Sashen'ka', 'Tavricheskaya', 'Ugolek', 'Ethika', 'Yaroslavna', 'Daria', 'Koralova', 'Lambert compact', 'Ponoare', 'Regina', 'Rivan', 'Skeena', 'Sylvia', 'Tentant'. Cherry varieties and hybrids with very large fruits (over 8.3 g) are revealed: 'Annushka', 'Legenda Mlieva', 'Burlat', 'Ferrovia', 'Germa', 'Irema BS', 'Scurator', '84-10/98', '94-30/41'. These genotypes were evaluated for winter hardiness and resistance to leaf spot also.

Winter hardiness

Despite the scale of work carried out by breeders in various climatic conditions, the most vulnerable place of cherry culture, genetically formed in Southern climatic conditions, remains weak winter hardiness. Winter hardiness is controlled polygenically and is inherited independently of other traits, but according to a number of authors, high winter hardiness is usually characteristic of smaller-fruited varieties. The possibility of combining winter hardiness with other economically valuable traits has been proved in the process of long-term selection.

The winter hardiness of the tree and flower buds is distinguished in cherries, as in other stone crops. These two traits tend to be poorly correlated. The main types of damage to cherry trees are the freezing of the bark of the stems and forks of skeletal branches, as well as the freezing of the cambium. In particularly severe winters with extremely severe frosts, freezing of all tree tissues can be observed. The general degree of freezing is determined according to the degree of freezing of tissues and organs of the plant.

The winter conditions in research years were not a critical nature for the studied varieties. Nevertheless, unstable weather, temperature fluctuations from positive to negative during the winter and spring periods had an impact on the safety of cherry trees. In the winter of 2017-2018 frosty weather was established with a decrease in air temperature to -20 ° C (26.02.) in the 3rd decade of February. In early March, the previously established frosty weather continued, but the minimum temperature did not fall below -15 ° C (01.03., 03.03.). The winter of 2018-2019 was characterized by an uneven change in the

temperature regime and precipitation. The strongest, but short-lived cold snap was observed on January 11 (the air temperature dropped to -22.1 °C at night). The winter of 2019-2020 was abnormally warm with uneven precipitation. The average monthly temperature in December was -3.4 °C, which is 5.1 °C higher than normal. Similar weather was established in January, and amounted to -4.5 °C, which is a record high temperature for January. The lowest temperature in the winter of 2019-2020 was -7.2° on February 8.

Large fruited cvs. 'Annushka', 'Legenda Mlieva', 'Burlat', 'Ferrovia', 'Germa', 'Irema BS', 'Scurator' and selections '84-10/98' ('Narodnaya' o.p.), '94-30/41' ('Vityaz' x 'Aelita') were evaluated for further selection based on a set of characteristics including the winter hardiness of trees. The overall degree of damage of the tree was noted according to the 9-scores system. The best adaptability to winter conditions showed cvs. 'Annushka', 'Burlat', 'Irema BS' and selections '84-10/98', '94-30/41', the overall degree of frost damage which in studies has not exceeded estimates in 1 score – very weak damage: wood yellowish, small superficial burns of the bark on the trunk and skeletal branches, the damage of the ends of annual shoots, damage part of generative organs no more 10 %. The trees have not affected the growth, well-foliated.

The total degree of frost damage of trees of the 'Legenda Mlieva', 'Germa' and 'Scurator' cvs. is estimated at 3 scores – weak damage: light brown wood, weak surface burns or small but deep damage to the bark, frost damage and drying of annual shoots and attacks of small branches; death of generative organs up to 25 %. The growth of the trees is weakened, leaves are normal.

Mid-weak winter hardiness was shown by trees of cv. 'Ferrovia', the total degree of frost damage of which was estimated at 5 scores: dark brown wood, moderate burns, significantly damaged bark with its deadening to wood; a significant part of semi-skeletal and skeletal branches died; the death of a significant part of generative organs up to 50 %. The trees have weak growth and small leaves.

Resistance to leaf spot

The main biotic stressor in Belarus is leaf spot (pathogen - *Coccomyces hiemalis* Higgins, *Blumeriella jaapii* (Rehm.) Arx) which directly affects at the winter hardiness of cherry trees (Vyshinskaya and Taranau, 2008).

The studied genotypes of sweet cherry showed different resistance to leaf spot. The trees of cv. 'Annushka' and selections '84-10/98', '94-30/41' showed the greatest resistance to this pathogen. These cvs. had maximum lesions, estimated at 3 scores (up to 10% of the plant or organ surface was affected, the spots were small, few, sporulation was weak or moderate), which allows them to be classified as very moderately resistant.

The remaining cvs. 'Legenda Mlieva', 'Burlat', 'Ferrovia', 'Germa', 'Irema BS', 'Scurator' had up leaf spot to 5 scores (up to 25% of the plant or organ surface is affected, sporulation is moderate), which corresponds to the group of low-resistant ones.

Thus, there were highlighted Ukrainian cherry cv. 'Annushka' and selections '84-10/98', '94-30/41' by the set of traits – large fruit size, winter hardiness, resistance to leaf spot (table, figure 1-3). The selected cherry cvs. are characterized by large (9.0-10.0 g), dark red skin color with tough pulp ('bigarreau' type) of fruits. They have high taste score of fruits (8.6 points), are highly winter hardy and medium-resistant to leaf spot. They have different maturation periods: 'Annushka' – early fruit ripening time, '84-10/98' – medium and '94-30/41' – late fruit ripening time.

There were selected by set of economic traits two Belarusian selections: '84-10/98' and '94-30/41' with dark colored very large (9.0-10.0 g) fruits of excellent dessert taste (tasting score 8.7), resistance to winter frost and leaf spot.

3. Conclusions

A reliable way to create varieties is hybridization using donors and sources of valuable traits, revealed as a result of studying the genetic collections of fruit plants. The cherries collection of RUE represents a bank for the conservation of genetic diversity and an important source of traits.

273 accessions of sweet cherry from different countries have been screened for winter hardiness, resistance to leaf spot and quality of fruits. Only three accessions were identified with a complex of the desired features: large fruit size, excellent dessert taste, high winterhardiness, and resistance to main disease. There were identified two Belarusian selections: '84-10/98' and '94-30/41' with medium and late fruit ripening term and the Ukrainian cv. 'Annushka' with early fruit ripening term. They are recommended to use for registered to State testing variety in Belarus and cherry breeding.

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Tables and Figures

Table 1. Characteristics of 3 genotypes selected from sweet cherry collection

Genotype	Fruit weight, g	Fruit color	Pulp density	Ripeness time	Taste score	Cherry leaf spot damage score (0-9)	Frost damage score (0-9)
Annushka	9.0	dark red	'bigarreau'	early	8.6	3	1
84-10/98	9.0	dark red	'bigarreau'	medium	8.6	3	1
94-30/41	10.0	dark red	'bigarreau'	late	8.6	3	1



Fig. 1. 'Annushka'



Fig. 2. '84-10/98'



Fig. 3. '94-30/41'