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INHERITANCE OF ECONOMIC TRAITS OF *MICROCERASUS TOMENTOSA THUNB.* INTERVARIETAL HYBRIDS

ABSTRACT: A hybrid fund of *Microcerasus tomentosa* comprising 6 families with a total of 287 plants has been created. The features of the inheritance of important economic traits in hybrid offspring intervarietal hybrids *Microcerasus tomentosa* are defined. The hybrid family and cross combinations with high features of macrocarpa, small fruit size, dry berry separation, vitamin C, immunity and precocity are defined. During the study period of controlled hybrid offspring of crosses a number of elite seedlings was identified – Натали х Юбилейная, Натали х Смуглянка восточная, and Натали х Розовая урожайная that combine high rates of fruit weight with other economic traits.

KEYWORDS: *Microcerasus tomentosa*, *Monilia cinerea*, intervarietal hybridization, reciprocal hybrids

INTRODUCTION

Plant breeding success is largely dependent on the source of material and the degree of scrutiny. Varied primary sources are a reliable reserve of the selective breeding process. Allocation from the created gene pool of economic traits, preparation of new genetic donors in the actual directions of selective breeding, and development of the effective methods of their involvement in programs of the selective breeding are of crucial importance.

The fruit crop *Microcerasus tomentosa* is a promising crop for cultivation in Belarus. It covers the territory from the Pacific Ocean to the Himalayan Mountains and mountainous Turkestan in Central Asia [Царенко, 2004] and has a range of ecological plasticity and sufficient frost hardiness. *Microcerasus tomentosa* is

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widely introduced in Japan, China, Korea and the Far East – Khabarovsk and Primorsky regions of Russia. *Microcerasus tomentosa* is found to be promising for cultivation in the harsh conditions of the Canadian Prairies and in the north of the United States [Еремин, 1996; Казьмин, 1975; Михеев, 1990].

Almost none of the varieties of *Microcerasus tomentosa* is found suitable for the ground and climatic conditions of the Republic of Belarus. Only some of them are recommended for home gardening. This is primarily due to the lack of varieties resistant to *Monilia cinerea* and a large percentage of plant death at the age of 8–12 years in commercial orchards, low transportability of berries (wet berry separation and juice loss), absence of self-fertile varieties, very early flowering (without pollinators), and damping-off root collar in the spring. However, the cultivation of this crop is justified because of its early appearance, high annual yield, and resistance to frost and coccomycosis [Бученков, 2000; Царенко, 2004].

Michuryn I. V. was the first who came across *Microcerasus tomentosa* and introduced it to the gardens of the European part of Russia in 1923. First scientifically based selective breeding of *Microcerasus tomentosa* started in the 1930s by Tikhonov N. N. and continued by Kazmin G. T in the 1940s–50s. Since the 1970s the work on cherry selective breeding was continued by Carenko V. P. and Carenko N. A. [Еремин, 1996; Казьмин, 1975; Михеев, 1990].

The aim of our work is to analyze *Microcerasus tomentosa* hybrid offspring of our breeding and the selection of the promising forms.

MATERIAL AND METHODS

Studies on intervarietal hybridization and analysis of morphological and biological characteristics were performed from 2004 to 2012. This article presents the average values after nine years of research.

The object of research is a hybrid offspring out of intervarietal crossing of 6 *Microcerasus tomentosa* varieties: Ранняя розовая, Хабаровчанка, Смуглянка восточная, Юбилейная, Розовая урожайная, and Натали.

Hybridization, field observations and experiments were performed [Седова, 1999]. The hybrid forms were evaluated by diameter and weight of the fruit, the ratio of fruit weight to stone mass, type of separation of fruit, the vitamin C content, resistance to *Monilia cinerea*, and the timing of entry into fruition.

Resistance to *Monilia cinerea* was scored on the general status of plants: 1 point bushes perfectly healthy; 2 points – slight damage (individual twigs), 3 points – average loss (about 30% of twigs), 4 points – severe loss (up to 50% of twigs), 5 points – lesions on more than 50% of twigs, no gain.

Berry weight was determined by weighing 100 randomly selected fruits. Ascorbic acid content in berries in the phase of full ripeness was determined by the indophenol method.

RESULTS AND DISCUSSION

As a result of intervarietal hybridization in 30 cross combinations, 4,064 flowers were pollinated, 2,227 seeds received, and 861 seedlings grown (Table 1). After culling, 287 plants were selected for further study.

Table 1. Some features of intervarietal hybrids of *Microcerasus tomentosa* varieties (aggregated data over 9 years)

Crossing combination	Pollinated flowers, pieces	Accounting of ovary		Collected fruits		Grown seedling	
		pieces	%	pieces	%	pieces	%
Ранняя розовая х Хабаровчанка	126	77	61.11	71	56.35	25	19.84
Ранняя розовая х Смуглянка восточная	141	80	56.74	73	51.75	27	19.15
Ранняя розовая х Юбилейная	136	75	59.15	64	47.06	18	13.24
Ранняя розовая х Розовая урожайная	128	73	57.03	68	53.13	23	17.97
Ранняя розовая х Натали	127	75	59.06	70	55.12	27	21.26
Хабаровчанка х Ранняя розовая	132	82	62.12	75	56.82	28	21.21
Хабаровчанка х Смуглянка восточная	121	85	70.75	79	65.29	31	25.62
Хабаровчанка х Юбилейная	146	86	58.90	80	54.79	36	24.66
Хабаровчанка х Розовая урожайная	134	83	61.94	77	57.46	39	29.10
Хабаровчанка х Натали	124	84	67.74	80	64.52	35	28.23
Смуглянка восточная х Хабаровчанка	145	77	53.10	71	48.97	27	18.62
Смуглянка восточная х Ранняя розовая	136	81	59.59	74	54.41	28	20.59
Смуглянка восточная х Юбилейная	125	78	62.40	72	57.60	32	25.60
Смуглянка восточная х Розовая урожайная	142	74	52.11	66	46.48	19	13.38
Смуглянка восточная х Натали	137	69	50.36	60	43.80	15	10.95
Юбилейная х Смуглянка восточная	144	72	50.00	67	46.53	20	13.89

Юбилейная х Хабаровчанка	126	68	53.97	62	49.21	17	13.49
Юбилейная х Ранняя розовая	131	67	51.15	61	46.56	14	10.69
Юбилейная х Розовая урожайная	147	71	48.90	67	45.58	19	12.93
Юбилейная х Натали	150	73	48.67	69	46.00	23	15.33
Розовая урожайная х Юбилейная	123	85	69.11	78	63.41	29	23.58
Розовая урожайная х Смуглянка восточная	135	88	65.19	82	60.74	40	29.63
Розовая урожайная х Хабаровчанка	149	86	57.72	79	53.02	28	18.79
Розовая урожайная х Ранняя розовая	132	84	63.64	76	57.58	30	22.73
Розовая урожайная х Натали	137	87	63.50	80	58.39	36	26.28
Натали х Розовая урожайная	125	92	73.60	86	68.80	41	32.80
Натали х Ранняя розовая	147	94	63.95	88	59.86	43	29.25
Натали х Хабаровчанка	145	91	62.76	83	57.24	35	24.14
Натали х Смуглянка восточная	133	90	67.68	84	63.16	37	27.82
Натали х Юбилейная	140	93	66.43	85	60.71	39	27.86

It is established that Натали and Хабаровчанка grades are characterized by higher rates of set of fruits at cross-pollination, where the maternal plant is Натали grade.

One of the main objectives of *Microcerasus tomentosa* selection is the increase in the size of fruits. The analysis of average values of diameter and mass of fruits has shown that their maximum values are typical of hybrid families where the maternal plant is Натали grade (Table 2). The analysis of hybrid progeny has revealed significant differences in combining ability of the original parental grades on the basis of the diameter of fruits. Most of the studied grades significantly exceeded their offsprings. Field evaluation of hybrid seedlings, conducted in different years showed that the highest yield of large-fruited plants is observed in those combinations where both or one of the parents had adequate high rate. Thus, in combinations of crossing Натали х Смуглянка восточная, Юбилейная х Смуглянка восточная, and Розовая урожайная х

Смуглянка восточная the share of seedlings with large fruits was 72.5–85.7%, and in combinations of Натали х Юбилейная, and Натали х Розовая урожайная – above 90%. The analysis of medium-sized fruits has shown that in a hybrid family where the parent variety is Ранняя розовая, diameter is 1.64 ± 0.15 cm; Хабаровчанка – 1.47 ± 0.12 cm; Смуглянка восточная – 1.69 ± 0.16 cm; Юбилейная – 1.77 ± 0.18 cm; Розовая урожайная – 1.73 ± 0.17 cm; and Натали – 1.82 ± 0.19 cm (Table 2). Maximum diameter of fruits recorded in reciprocal hybrids of Натали х Юбилейная is 1.94 ± 0.21 cm.

The analysis of hybrid offspring has shown that the greatest number of plants in the progeny of grades with different fruit weight usually occupies an intermediate position between the parental forms. However, in most combinations of individual seedlings some were superior to the best parent form of the analyzed lines.

The evaluation of a number of fruit *Microcerasus tomentosa* parental forms and intervarietal hybrids has identified a close relationship between the manifestation of this trait and the characteristics of the genotype. It was found that the source of increased mass of berries are Натали and Юбилейная grades. In all hybrid combinations involving these grades, obtained transgressive seedlings (from 6.5% to 12.8%) with fruit weight 3.9–4.6 g, and their output did not depend on the maternal or paternal form used.

It was found that the average fruit weight in the hybrid family with Ранняя розовая as the mother grade was 2.25 ± 0.17 g; Хабаровчанка – 2.05 ± 0.14 g; Смуглянка восточная – 2.55 ± 0.19 g . Юбилейная – 3.55 ± 0.21 g; Розовая урожайная – 3.05 ± 0.20 g; and Натали – 4.00 ± 0.23 g (Table 2).

Table 2. Quality of fruits of varieties of *Microcerasus tomentosa* (aggregated data over 9 years)

Hybrid family (maternal grade)	Diameter of a fruit, cm	Mass of a fruit, g.	Mass of a stone, g. (%)	Type of a separation of a fruit	Content of vitamin C, мg/ 100 g.
Ранняя Розовая	1.64±0.15	2.25±0.17	0.18±0.03 (8.00)	damp	19.9±1.7
Хабаровчанка	1.47±0.12	2.05±0.14	0.17±0.02 (8.29)	damp	18.7±1.5
Смуглянка восточная	1.69±0.16	2.55±0.19	0.19±0.04 (7.45)	semi-dry	25.4±1.9
Юбилейная	1.77±0.18	3.55±0.21	0.21±0.05 (5.92)	semi-dry	32.5±2.4
Розовая урожайная	1.73±0.17	3.05±0.20	0.20±0.04 (6.56)	damp	23.5±1.8
Натали	1.82±0.19	4.00±0.22	0.21±0.05 (5.25)	semi-dry	30.6±2.1

The value of *Microcerasus tomentosa* grades is also defined by a ratio of mass of edible part to the mass of a stone. The volume of waste in many respects depends on this indicator. According to Мегердичев Е. Я. the stone has to be small, not comprising more than 7%. The average stone mass in the hybrid family with Ранняя розовая as the mother grade was 0.18 ± 0.03 g; Хабаровчанка – 0.17 ± 0.02 g; Смуглянка восточная – 0.19 ± 0.04 g; Юбилейная – 0.21 ± 0.05 g; Розовая урожайная – 0.20 ± 0.04 g; and Натали – 0.21 ± 0.05 g. Our research showed that smaller stones are typical of the reciprocal hybrids of Натали х Юбилейная (5.76%) and Натали х Розовая урожайная (6.28%), and larger ones for Хабаровчанка х Ранняя розовая (8.17%) and Хабаровчанка х Смуглянка восточная (7.86%) (Table 2). Minimal stone mass is fixed in reciprocal hybrids Натали х Юбилейная. In hybrid families Натали х Юбилейная and Натали х Розовая урожайная the share of transgressive seedlings for this indicator was 9.5% and 18.7 %, respectively.

The study of vitamin C content in the period of biological ripeness of fruits showed that in hybrid families this indicator changes, ranging from 18.7 to 32.5 mg/100 g. In fruit hybrids, where the mother plant is Ранняя розовая, the average content of vitamin C is 19.9 ± 1.7 mg/100 g; Хабаровчанка – 18.7 ± 1.5; Смуглянка восточная – 25.4 ± 1.9; Юбилейная – 32.5 ± 2.4; Розовая урожайная – 23.5 ± 1.8; Натали – 30.6 ± 2.1 (Table. 2). Selection estimation of intervarietal *Microcerasus tomentosa* hybrids indicates the possibility of obtaining forms with high vitamin C content by excision in the hybrid offspring of transgressive genotypes. The most effective donors of these traits were Юбилейная and Натали grades. However, the determination of the degree of dominance revealed that inheritance of vitamin C inclines to a worse parent, and even depression in most of the studied families. The heterotic effect was only found in Натали х Юбилейная family.

The study of hybrid forms on the basis of separation of fruits showed that the dry berry separation is typical of hybrids where maternal plants are Смуглянка восточная, Юбилейная, and Натали grades (Table 2).

Offspring of varieties crossed with a wet margin fruit was mainly characterized by low rate of the studied trait, and a significant portion of seedlings had a negative transgression. In combination with the best of these parents, there were identified transgressive seedlings superior to parents. Thus, in Натали х Юбилейная and Натали х Смуглянка восточная families there was found 40.7% and 56.5% respectively of plants with dry margin.

As a result of the analysis of *Microcerasus tomentosa* hybrids stability to *Monilia cinerea* it is established that hybrid families significantly differ due to this indicator. Absolutely steady forms have not been revealed. Hybrid families where maternal plants were Смуглянка восточная, Юбилейная, and Натали grades were put into relatively stable group (loss 2 points); with average

steadiness (3 points) – Розовая урожайная; unstable (4 points) – Ранняя розовая, and Хабаровчанка (Table 3).

The assessment of hybrid fund on the basis of an early maturing of fruits allowed to define that the earliest introduction in fructification is typical of hybrid families where maternal plants were Натали and Юбилейная grades (Table 3).

Early introduction in fructification is particularly noted in the reciprocal combinations of Натали х Юбилейная where more than 50% of seedlings enter a fructification period on the 3rd year of vegetation.

Table 3. Stability to *Monilia cinerea* and early maturing of fruits of *Microcerasus tomentosa* varieties (aggregated data over 9 years)

Hybrid family (maternal grade)	Stability to *Monilia cinerea*, point	Introduction in fructification, year
Ранняя розовая	4	4
Хабаровчанка	4	5
Смуглянка восточная	2	4
Юбилейная	2	3
Розовая урожайная	3	4
Натали	2	3

CONCLUSION

The hybrid fund of 6 families and 287 plants by the way of inter-high quality hybridization of *Microcerasus tomentosa* has been created.

Hybrid families, where maternal plants are Смуглянка восточная, Юбилейная, and Натали grades, have high features of macrocarpa, a small fruit size, dry berry separation, and vitamin C.

The hybrid forms of families, where maternal plants are Смуглянка восточная, Юбилейная, and Натали grades, can be used as an initial material in the selection of *Monilia cinerea* stability.

The early introduction in fructification is typical of hybrid families with Юбилейная and Натали grades.

During the study period of controlled hybrid offspring of crosses a number of elite seedlings was identified – Натали х Юбилейная, Натали х Смуглянка восточная, and Натали х Розовая урожайная, that combine high rates of fruit weight with other economic traits.

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НАСЛЕЂИВАЊЕ ЕКОНОМСКИХ ОСОБИНА КОД *MICROCERASUS TOMENTOSA THUNB.* МЕЂУСОРТНИХ ХИБРИДА

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РЕЗИМЕ: Направљен је хибридни фонд *Microcerasus tomentosa* који се састоји од шест породица са укупно 287 биљака. Дефинисане су карактеристике наслеђивања важних економских особина хибридног потомства *Microcerasus tomentosa* међусортних хибрида. Одређена је хибридна породица као и унакрсне комбинације са високим обележјима великог и малог плода, сепарацијом сувих бобица, витамином Ц, имунитетом и превременим развојем. Током периода истраживања контролисаног укрштеног хибридног потомства, установљен је број елитних садница − Натали х Юбилеиная, Натали х Смуглянка восточная и Натали х Розовая урожаиная које комбинују високу стопу тежине плода са другим економским особинама.

КЉУЧНЕ РЕЧИ: *Microcerasus tomentosa*, *Monilia cinerea*, међусортна хибридизација, реципрочни хибриди

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