

Berry bushes in the landscape architecture of urban megacities

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Abstract. Along with traditional and popular berry crops in private gardens, there are few common types and decorative forms. The purpose of the research was to expand the range of ornamental shrubs in the landscaping of large Metropolitan areas and to popularize knowledge about new or little-known types of berry bushes. As a result of studies on the value of the adaptation coefficient, the studied shrub species were divided into three groups according to the degree of prospects. The most promising group consisting of 65% of samples was the first, whose representatives were characterized by high winter hardiness and the ability to complete seed propagation, decorative. The average prospective second group includes 20 % of the studied samples. This includes plants that remain decorative during the growing season, are able to reproduce by seeds, but they are less promising than the representatives of the 1st group, due to the inability to maintain decorativeness in the growing season and do not give offspring by self-seeding. The third group, which was not promising, included 15 % of samples. Species of shrubs belonging to this group are quite hardy, have the ability to seed propagation.

1 Introduction

Today, one of the priorities of urban planning is to ensure harmonious human development in an urban environment with its high man-made loads. Solving this problem is impossible without increasing the norm of green spaces per resident of megacities [2,15].

The main element of the natural environment in the city are not only trees, but also shrubs. Decorative trees and shrubs are familiar for urban landscaping, but berry shrubs are still little common [1, 7, 8].

In recent years, berry shrubs are used for greening cities with a decorative purpose, to expand the range. Berry shrubs have a great variety of species, and even more so a huge variety of varieties that can be applied in landscape landscaping. The advantages of this type of landscaping are aesthetics, ecology and cost-effectiveness, as well as the cognitive

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purpose - to familiarize the population with existing species and varieties and especially new breeding products [3 – 5, 9-12].

2 Research methods

Positive success of introduction depends, first of all, on the degree of adaptation of introductions to new environmental conditions [4, 13].

To detect adaptability in species of ornamental shrubs to the ecological conditions of megacities, we have applied a method of integral assessment [6-7, 13-17]. The evaluation is based on seven bioecological indicators: winter resistance, gabbitus preservation, escape-forming ability, regularity of shoots growth, ability to generative development, possibility of artificial vegetative reproduction, as well as decorativeness [3, 9, 13-14]. These indicators characterize the condition of the plant at the place of introduction and are determined by systematic visual observations. For each indicator, numerical values in points were selected, corresponding to a certain state of the plant. Based on the integral assessment, the total viability score of the shrubs was calculated separately for each year of observations and the average score for the period of observations. Integral numerical expression of the viability of introduced plants is the sum of average scores [1, 9, 13, 16].

3 Research results

On the basis of their own research [8-13], a table (table 1) on the use and decorative value of different types of berry and fruit plants in populated areas has been drawn up during the work with berry crops since 1990 and the study of literary sources on the greening of populated areas in Russia's cities and villages. Table 1 presents the main species, varieties and ornamental forms of berry shrubs, which can be used as landscaping of urban gardens and parks. The peculiarity of these cultures is the high decorativeness, unpretentiousness and adaptability to urban conditions, without losing their decorative qualities [2, 9, 10].

Table 1. Promising types of berry shrubs for urban landscaping

Species name	Variety name	Decorative qualities; duration of flowering, vegetation (days)	Directions use in urban landscaping (landing type). Trouble
<i>Cerasus vulgaris</i> Mill.	<p><i>Self-fertile varieties:</i> Xenia, Nochka, Vstrecha</p> <p><i>Early varieties:</i> Shokoladnitsa, Chudo- vishnya</p> <p><i>Medium varieties:</i> Turgenevskaya, Morozovka</p> <p><i>Late varieties:</i> Lubskaya, Malinovka</p> <p><i>Decorative forms:</i> f. plena f. umbraculifera f. Rexii f. persicifolia f. semperflorens f. aureo-variegata</p>	<p>Decorative: crown, leaf, bark, tswe-tok, fruit.</p> <p>Vegetation - April-September; Blossoming - May (10-14 days); Fertility - June-July;</p>	<p>Solitaire, group, high hedge, kurtin, ordinary landing.</p> <p>When a dense planting is affected by diseases and pests; Activities: preventive treatment, pruning.</p>

European dwarf cherry - <i>Cerasus fruticosa</i> Pall.	<i>Decorative forms:</i> <i>f. pendula</i> <i>f. variegata</i>	Decorative: crown, leaf, bark, flower, fruit. Vegetation - April-September; Blossoming - May (5-12 days); Fertility - June;	Solitaire, group, high hedge, kurtin, ordinary landing.
Nanjing cherry - <i>Cerasus tomentosa</i> (Thunb.) Wall.	<i>Early varieties:</i> Natali, Detskaya; <i>Medium varieties:</i> Ubileynaya, Belaya; <i>Late varieties:</i> Okeanskaya, Virovskaya	Decorative: leaf, flower, fruit. Vegetation - April-October; Blossoming - May (5-10 days); Fertility - July;	Group or single planting, low hedge, kurtin. Requires wind-protected places, does not tolerate heavy, damp soils.
Chinese bush cherry – <i>Cerasus glandulosa</i> (Thunb.) Loisel.	<i>Rosea,</i> <i>Terry forms:</i> <i>Rosea plena,</i> <i>Alba plena</i>	Decorative: leaf, terry flower, bark. Vegetation - May-October; Blossoms - June-July;	Solitaire, decorative group, rocky devices. Requires wind-protected places, does not tolerate heavy, damp soils.
Sea-buckthorn – <i>Hippophae rhamnoides</i> L.	Altayskaya, Perchik, Botanicheskaya, Vitaminnaya, Ryabinka, Botanicheskaya aromatnaya, Pamyati Vehova, Timiryazevskysya krasavitsa, Parad	Decorative: crown, leaf, fruit. Vegetation - May-September; Fertility - July-October;	Solitaire, group, curtina, rank landing. When planting requires the edging of the root system, gives a lot of overgrowth. Activities: pruning.
European gooseberry, - <i>Grossularia reclinata</i> (L.) Mill.	Berill, Uralsky izumrud, Grushen'ka, Alladin, Afrikanets, Kolobok, Laskoviy, Rodnik, Rozoviy 2, Sadko, Slavny	Decorative: gabbitus, leaf, fruit. Vegetation - April-September; Blossoming - May (5-7 days); Fertility - July;	Solitaire, group, low hedge, kurtin, ordinary landing. When a dense planting is affected by diseases and pests; Activities: preventive treatment, pruning.
Golden currant - <i>Ribes aureum</i> Pursh	Shafak, Venera, Lyaisan, Businka, Nahodka, Fatima, Zarina	Decorative: gabbitus, flowers, leaf, fruit. Vegetation - April-October; Blossoming - May (5-10 days); Fertility - July-August	Solitaire, group, low-cut hedge, curtine, ordinary planting.
American black currant - <i>Ribes americanum</i> Mill.	Sladkoplodnaya, Missouri, Pluton	Decorative: leaf, flower, fruit. Vegetation - May-October; Blossoms - May; Fertility - June-August	Living hedge low, medium, kurtin, group, private planting

Black currant - <i>Ribes nigrum</i> L.	<i>Early varieties:</i> Ekzotika, Perun <i>Medium varieties:</i> Dubrovskaya, Venera, <i>Late varieties:</i> Lentyai, Arcadia	Decorative: leaf, flower, fruit. Vegetation - April-October; Flowering - April; Fertility - June;	The hedge is low, medium, kurtin, group, ordinary landing. When a dense planting is affected by diseases and pests; Activities: preventive treatment, pruning.
Red currant – <i>Ribes rubrum</i> L.	<i>Early varieties:</i> Rannyaya sladkaya, Chulkovskaya <i>Winter-resistant varieties:</i> Uralskaya krasavitsa, Alaya zor'ka <i>Large-fruited varieties:</i> Alfa, Baraba <i>Decorative-leaf varieties:</i> Konstantinovskaya	Decorative: gabbitus, leaf, flower, fruit. Vegetation - April-October; Flowering - April; Fertility - July-August;	Solitaire, hedge low, middle, kurtin, group, ordinary landing. When a dense planting is affected by diseases and pests; Activities: preventive treatment, pruning.
Red raspberry – <i>Rubus idaeus</i> L.	<i>Large-fruited varieties:</i> Gerakl, Krasa Rossii <i>Remontant varieties:</i> Bryanskoe divo, Jar-ptitsa <i>Stamp varieties:</i> Oktavia, Tarusa	Decorative: leaf, flower, fruit. Vegetation - April - September; Blossoms - June-July; Fertility - July-August;	Group and solitary landing, undergrowth. When a dense planting is affected by diseases and pests; Activities: preventive treatment, pruning.
Black raspberry - <i>Rubus occidentalis</i> L.	Cumberland	Decorative: leaf, coloring shoots, flower, fruit. Vegetation - April - September; Blossoms - June-July; Fertility - July-August;	Group and solitary landing, undergrowth. Requires support For the winter period removed from the support. Requires wind-protected places, does not tolerate heavy, damp soils.
Flowering raspberry - <i>Rubus odoratus</i> L.	Tridel <i>Decorative forms:</i> <i>f. alba</i>	Decorative: leaf, flower, fruit. Vegetation - April - September; Blossoms - June-July; Fertility - July-August;	Group and single planting, jackets, low, medium hedges
Arctic raspberry – <i>Rubus arcticus</i> L.	Anna, Beat, Linda, Mespi, Mesma, Pima, Yalamanchin, Aura, Astra, Valentina	Decorative: leaf, flower, fruit. Vegetation - April - September; Blossoms - June-July; Fertility - July;	Group and solitary planting, undergrowth, like a soil cover plant in the shade

Haskap – <i>Lonicera caerulea</i> L.	<i>Early varieties:</i> Altair, Goluboye vereteno <i>Medium varieties:</i> Nimfa, Sinaya Ptitsa <i>Late varieties:</i> Leningradsky Velikan	Decorative: flower, fruit. Vegetation - April - September; Flowering -March-April; Fertility May - June;	Single or in groups, to form free hedges
Snowy mespilus - <i>Amelanchier ovalis</i> Med.	Moonlake, Nelson, Regan, Slate, Smoky	Decorative: crown, leaf, flower, fruit. Vegetation - April - October; Blossoms - May Fertility - June - July;	As a middle tier in a group, on the edges. Solitaire, hedge, curtain, group, ordinary landing.
Small cranberry - <i>Vaccinium oxycoccos</i> L.	Alaya zapovednaya, Dar Kostromy, Krasa Severa, Sazonovskaya, Severyanka, Sominskaya, Hotavetskaya, Pilgrim, McFarlin, Ben Lear	Decorative: leaf, flower, fruit. Vegetation -March-October; Blossoms - May Fertility August;	Group planting, soil cover plant, imitation of "swamp." Requires specially prepared moistened, acidic, poor soils
Northern highbush blueberry <i>Vaccinium corymbosum</i> L.	Golubaya Rossyp', Divnaya, Izyaschnaya, Iksinskaya, Bluetta, Bonus, Brigitta, Nortland, Peka Patriot, Pink Lemonade	Decorative: gabitus, flower, fruit. Vegetation - April - September; Blossoms - June; Fertility - July;	Group and solitary planting, curtain, undergrowth of conifers. Requires acidic, drained, well-fertilized soils
Lingonberry <i>Vaccinium vitis-idaea</i> L.	Kostromychka, Kostromskaya Rozovaya, Rubin, Runo Belawskie, Erntesegen	Decorative: leaf, flower, fruit. Vegetation -April-October; Blossoms - May Fertility August;	Group planting, soil cover plant, imitation of "swamp." Requires specially prepared moistened, acidic, poor soils
Guelder-rose – <i>Viburnum opulus</i> L.	Buldenej, Souzga, Tayejnye Rubiny, Jolobovskaya, Zarnitsa, Vigorovskaya	Decorative: leaf, flower, fruit. Vegetation -April - October. Blossoms - May Fertility September	As a middle tier in a group, on the edges. Solitaire, hedge, curtain, group, ordinary landing.

Sustainability and the prospect of the use of plants in urban landscaping is characterized by a set of important features and is expressed in the point assessment of each studied species. Comprehensive studies on 7 key features are presented in Table 2.

Many ornamental species of shrubs during observations we have almost no recorded damage from low temperatures, their shoots by the end of the growing season tree by 90 - 100% and only in severe winters there is a dying of ends in late-vegetative shoots. This freezing of the tops of annual growths is caused by unstable winters with sharp fluctuations in temperature and thaws, which were observed in the years of research. However, the presented ornamental types of shrubs easily rise above-ground, annually bloom and bear fruit.

Table 2. Integral assessment of the prospects of some ornamental types of garden shrubs.

Species	Winter resistance	Drought resistance	Resistance to pests and diseases	Increase	Generative development	Sustainability in crop	Decorativeness	Points	Adaptation ratio	Prospective group
<i>Cerasus vulgaris</i>	4	5	5	5	4	5	10	38	95,0	1
<i>Cerasus fruticosa</i>	5	5	4	5	4	5	10	38	95,0	1
<i>Cerasus tomentosa</i>	4	5	3	5	5	4	5	36	90,0	1
<i>Cerasus glandulosa</i>	4	5	5	5	4	5	10	38	95,0	1
<i>Hippophae rhamnoides</i>	4	5	4	5	5	5	10	38	95,0	1
<i>Grossularia reclinata</i>	4	4	5	5	5	5	10	38	95,0	1
<i>Ribes aureum</i>	5	5	5	5	5	5	10	40	100	1
<i>Ribes americanum</i>	5	5	5	4	5	5	10	39	97,5	1
<i>Ribes nigrum</i>	5	5	5	5	5	4	10	26,5	95,0	1
<i>Ribes rubrum</i>	5	5	5	4	5	5	10	39	97,5	1
<i>Rubus idaeus</i>	4	4	5	4	5	4	10	36	90,0	2
<i>Rubus nigrum</i>	3	4	4	4	4	4	9	32	80,0	2
<i>Rubus odorata</i>	4	5	4	4	4	4	10	32	80,0	2
<i>Rubus arcticus</i>	4	4	4	4	4	4	8	32	80,0	2
<i>Lonicera caerulea</i>	5	5	5	4	5	5	10	39	97,5	1
<i>Amelanchier ovalis</i>	5	5	4	5	5	5	10	39	97,5	1
<i>Vaccinium oxycoccos</i>	4	3	5	3	3	3	6	27	67,5	3
<i>Vaccinium corymbosum</i>	4	4	5	3	3	4	7	30	75,0	3
<i>Vaccinium vitis-idaea</i>	4	3	5	3	3	3	6	27	67,5	3
<i>Viburnum opulus</i>	5	4	5	5	5	5	10	39	97,5	1

Thus, in the conditions of introduction in Moscow and the region shrubs are stable, the shoots of which do not freeze in winter and almost completely woodpbre down by the end of the growing season.

When introduced in the conditions of the metropolis of Moscow, the vital form of the studied plants is preserved the same as they grew in the natural area - shrubs [1-2, 7-9]. After exposure to negative environmental factors, the escaping ability of plants determines the preservation or restoration of the crown gabitus. Studies have shown that all species we study have a high shoots forming ability [10-12].

The most important indicator of the plant's life is its growth. The growth of shoots is a generalized complex indicator, synthesizing not only the results of the plant's organism, which accumulates a complex effect on plants of the environment. The development and growth of shrubs is the most important indicator of plant adaptation in the introduction to new geographical areas [13-17]. Observations showed that all the samples studied had an

annual increase in shoots of between 9 cm and 1.3 m, which was due to the potential rate of bush growth.

The success of introduction is revealed as well as their reproductive ability. The formation of viable fertile seeds in plants indicates their sufficient adaptability to the environment in the metropolis. The production of viable seeds, which determine the development of sustainable seed generations, ensures that plants survive and spread in new conditions. Observations carried out in Moscow, revealed annual fruiting and the formation of viable seeds in all the species studied. As a result, the adaptation rate of the studied species of shrubs was divided by our degree of perspective into three groups. The most promising group consisting of 65% of the samples was the first, whose representatives were characterized by high winter resistance and ability to full-fledged seed reproduction, decorativeness.

The average second group includes 20% of the samples studied. This includes plants that during the growing season retain ornamental, capable of breeding seeds, but they are less promising than representatives of the 1st group, due to the inability to maintain ornamental in the growing season and do not give offspring self-seeding.

The third group was not a promising group, which included 15% of the samples. Species of shrubs, belonging to this group of enough winter-resistant, have the ability to seed reproduction, but were not promising due to high requirements for soil growing conditions and not high decorative qualities in the conditions of the metropolis.

However, seed reproduction of crops is the longest and most promising breeding method for these crops. Even with the traditional method of vegetative reproduction, it is impossible to quickly obtain the planting material in the right quantity and appropriate quality.

Now there are new and continue to improve promising high-tech ways of vegetative reproduction of garden crops, including not only the acceleration of breeding technology, but also the recovery of planting material, at the same time as the high output of the planting material and the high breeding rate, superior to the seed and traditional vegetative method of reproduction. This accelerated breeding technology allows to fully preserve the varietal and decorative qualities of breeding plants.

Table 3. Timeline of receipt of the planting material of berry shrubs by microclonal reproduction technology for the period from introduction to the end of adaptation, weeks.

Crop	Introduction	Reproduction	Rooting	Adaptation	Total weeks
Rubus (Raspberry)	6	6	3	4	19
Rubus (Blackberry)	6	6	3	4	19
Grossularia (Gooseberry)	6	8	3	4	21
Ribes (Currant)	4	8	3	3	18
Vaccinium (Blueberry)	12	8	6	6	32

According to Table 3, it can be concluded that the earliest time to obtain a planting material on accelerated technology is characterized by currants (18 weeks), raspberries and blackberries (19 weeks), longer in the time it takes to grow gooseberries - 21 weeks. The longest time (32 weeks) and the specific breeding process in blueberries, requiring strict adherence to all parameters.

For most of the studied cultures at the introduction stage used the environment MS (raspberry, blackberry, currant), for gooseberry - environment Lp, for blueberries - WPM environment. Almost all stages of reproduction require the addition of hormones: BAP, IAA in different concentrations and depending on culture.

For microclonal reproduction of raspberries and blackberries used the MS environment with the addition of BAP (mg/L) at the injection stage -0.8; Breeding - 0.7; Rooting was carried out on Wednesday 1/2 MS with the addition of IAA -0.4. For the reproduction of currants used the MS environment with the addition of VAR (mg/L) at the stage of introduction -0.4; breeding - 0.7 with the addition of IAA -0.1; rooting was carried out on the environment without hormones. For gooseberry used Lp environment with the addition of BAP (mg/l) at the injection stage -0.4; breeding - 0.2-0.4; 0.1 or without hormones. For blueberries used WPM environment with the addition of IP 5000 at the stages of introduction and reproduction, rooting was carried out on the environment without hormones.

When using these types of plants for urban landscaping, it is necessary to comply with the appropriate regulations for the greening of public spaces, squares, boulevards, gardens and parks. In particular, the use of bewitched species, with poisonous leaves, flowers and fruits, as well as plants that are strongly affected by diseases and damaged by pests are not allowed.

In the presented variety there are species containing thorns and thorns on shoots, such as gooseberry, buckthorn, raspberries, but the variety is selected in such a way that it includes varieties with little or no thorns and thorns (table 1).

Almost all crops do not require special soil preparation for most crops, the exception is representatives of the Family of Heather (cranberries, cranberries, blueberries), requiring special poor, loose, acidic and moisturized soils.

Most species have ornamental flowers, inflorescences and small, bright edible fruits. With small sizes and the number of fruits excluded damage coatings, bad smell in the fall of fruits and the desire of visitors to gardens and parks to use them in fresh form.

For some crops, which are popular fruit or berry crops (cherry, currant, raspberries), characteristic of frequent damage to pests and diseases in the absence of proper care. But it is not necessary to abandon them for the purposes of urban landscaping, as they give landscapes a special attraction and carry an important practical wash - it is the popularization of knowledge about such cultures in the population. To maintain the decorativeness of such plants, it is necessary to carry out regular pruning, formation, preventive treatment and agrotechnical techniques.

Thus, the presented assortment of shrubs is promising for urban landscaping. The use of these crops will expand the traditional range of shrubs for urban landscaping, together with ornamental trees they will create high-decorative plantings. With appropriate care and the level of agricultural engineering, the recommended species will look decorative, while also performing an important information and learning function.

4 Findings

1. The shrub species studied are divided by the degree of adaptation by degree of perspective into three groups.
2. The most promising group is the first - 65% of species (*Cerasus vulgaris* Mill., *Cerasus fruticosa* Pall., *Cerasus tomentosa* (Thunb.) Wall., *Cerasus glandulosa* (Thunb.) Loisel., *Hippophae rhamnoides* L., *Grossularia reclinata* (L.) Mill., *Ribes aureum* Pursh, *Ribes americanum* Mill., *Ribes nigrum* L., *Ribes rubrum* L.), whose representatives are characterized by high winter resistance and the ability to full-fledged seed and vegetative reproduction, decorativeness.
3. Medium-promising second group - includes 20% of the species studied (all *Rubus* species).
4. The third group is not a promising group, includes 15% of samples (*Vaccinium oxycoccos* L., *Vaccinium corymbosum* L., *Vaccinium vitis-idaea* L.), which are not

- promising due to high requirements for soil conditions and not high decorative qualities in the metropolis.
5. The technology of accelerated reproduction of berry crops has been developed. The timing of the planting material was 18 to 32 weeks. The following crops are particularly important: raspberries, blackberries, currants, gooseberries, 18-21 weeks.
 6. Elements of accelerated clonal breeding of berry crops for urban landscaping have been worked out and improved.

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