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Assessment of success of introduction of wood and shrubby plants in the conditions of the Zhezkazgan industrial region

At the article experience of introduction of woody plants in the Central Kazakhstan is analyzed. Modification of introduction division of the region and classification of groups of ecological plasticity of species of introduced species in the region is offered. The validity and efficiency of these developments is confirmed with the analysis of use of plants in green construction of the Central Kazakhstan. The principles of introduction mobilization of plants to the Central Kazakhstan are developed. Following the results of researches all trees have been broken into 4 categories: 1 — very perspective plants which can be applied widely in mass gardening of settlements of the Zhezkazgan region; 2 — perspective species which can be used for landing by the square and when gardening a park zone; 3 — unpromising species, suitable for creation of separate compositions and in private gardening; 4 — not perspective species demanding careful leaving and suitable only in private gardening and green construction.

Keywords: success of introduction, wood and shrubby plants, introduction, Zhezkazgan.

Introduction

Economic human activity is resulted by change of a microclimate of the cities. The industrial enterprises and housing estates united by the territory of the city promote increase in average annual and average daily temperatures of a ground layer of air, its faster warming up in comparison with surrounding areas. It is possible to soften a city microclimate by gardening of territories. So, the landings of plants located along facades of buildings and shading them reduce a high temperature of walls and surface by 22–35 % (7–13 ºC). Air temperature over a lawn is 4 ºC lower, than over asphalt covering of the sidewalk. Green plantings exert the softening impact on summer temperature condition on the next (within 100 m) to the territory of the city. It is found out that in a radius up to 100 m near the green massif air temperature is 1–1,5 °C lower, than on the others from the massif open places. It occurs owing to the increased circulation of air masses near green plantings. Warmer air in the open in solar territory rises up and on his place arrives colder of the neighboring green massifs.

Except protection against direct sunshine, green plantings exert a great influence on improvement of the radiation mode in the city. At the same time in actual practice a city environment only green massifs, considerable on the area, exert noticeable impact on a microclimate (including on the thermal mode) to the territory [1–4]. The Zhezkazgan region is located in the difficult climatic zone [5] which is characterized by high summer temperatures and deficiency of rainfall and also low winter temperatures with insignificant snow cover. Therefore important aspect is selection of plants for gardening, capable to maintain, both summer, and winter conditions.

Generalization of results the introduction researches of plants in the Central Kazakhstan has shown need of carrying out the preliminary area logy analysis of efficiency of donor regions of a look for attraction in culture in the Central Kazakhstan.

Research aim is to carry out assessment of an introduction of wood and shrubby plants for the Zhezkazgan industrial region.

Methodology

It is shown that in the Zhezkazgan region are most perspective a xerophytes and meso-xerophytes natural flora of Kazakhstan [6], that is attraction of those plants which grow in areas with similar geographical and climatic properties. Not absolutely the method of the choice of regions of donors for attraction of plants by the principle of climatic analogs works. So, according to this method, as successful group for an introduction North American and Central Asian types have to act. However, North American plants are in Zhezkazgan rather winter-hardy (the parameter regulated by the introduction forecast), but not rather drought-resistant. On the contrary, xerophytes and meso-xerophytes of the Central Asia successfully cope in the Central Kazakhstan with summer ecological stresses, but freeze slightly at winters [7–10].

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Features of climate show that the northern desert zone of the Central Kazakhstan (The Zhezkazgan industrial region) has practically no climatic analogs outside Kazakhstan. Therefore effectively to apply a method the cultural areas, that is to analyze experience of an introduction of wood and shrubby plants in more arid and more northern conditions.

By interpolation the behavior of species for Zhezkazgan's conditions which characteristics are intermediate between earlier studied [11] is predicted. Thereby, the interpolation forecast considers ecological ability of adaptation of species, if the species is viable in two points of a cultivating area differing from each other in intensity of the natural factors limiting its activity, then it will be viable in any third point of this region which ecological characteristics are intermediate concerning two starting points of cultivating area. Interpolation «pointed» forecasting is based on comparison of quantitative characteristics of the leading limiting factors (the minimum temperatures, the maximum temperatures, quantity of an atmospheric precipitation, etc.) in the compared geographical points of cultivating area.

Along with «pointed» interpolation forecasting, system and ecological approach to an introduction of plants assumes also «zone» forecasting on the basis of ranging of quality of the environment.

Results and discussion

For forecasting of success of an introduction of wood and shrubby plants in the conditions of the Zhezkazgan region experience in green construction in the following settlements has been analyzed: Bakanas — Zhezkazgan — Zhairem — Ekibastuz — Karaganda.

By results the introduction tests in these settlements 73 species of trees have been recommended. Including in Bakanas 25 species, in Zhezkazgan — 26 species, in Zhairem — 17 species, Ekibastuz — 15 species are recommended, to Karaganda — 63 species. From the provided data it is obvious that recommendations to green construction temporary the introduction point is more limited, than the recommendations of the botanical gardens which are settling down in the same introduction zone as a temporary point. In the central introduction area of Zhairem 65 % of number of species of the trees recommended by the Zhezkazgan botanical garden are recommended. We will consider distribution of the recommended species of trees on introduction zones of the Central Kazakhstan (Table 1). 15 species are recommended for all three introduction zones. The ecological plasticity of these species covers all variety of conditions of the habitat in the analyzed ecological range, and therefore they can be defined as the «fully-spectral» (FS).

Table 1

Number and ecological plasticity of species of the trees recommended introduction points for use in gardening

Group of ecological plasticity in the Central Kazakhstan	Introduction zones of the Central Kazakhstan					Total species in group of ecological plasticity
	Southern	Central		Northern		
	Bakanas	Zhezkazgan	Zhairem	Ekibastuz	Karaganda	
Fully-spectral (FS)	15 / 100,0	15 / 100,0	10 / 66,7	9 / 60,0	15 / 100,0	15 / 100,0
FS by temperature regime, it is limited to deficiency of moisture (LDM)	4 / 100,0	– / 0,0	0 / 0,0	2 / 50,0	4 / 100,0	4 / 100,0
Southern (S)	6 / 100,0	– / 0,0	– / 0,0	– / 0,0	– / 0,0	6 / 100,0
Central (C)	– / 0,0	4 / 100,0	– / 0,0	– / 0,0	– / 0,0	4 / 100,0
Southern-Central (SC)	– / 0,0	7 / 100,0	7 / 100,0	3 / 42,9	7 / 100,0	7 / 100,0
Northern (N)	– / 0,0	– / 0,0	– / 0,0	2 / 2,7	37 / 100,0	37 / 100,0
Total:	25	26	17	15	63	73
Share from the total number of species of the region, %	34,2	35,6	23.3	20,5	86,3	100,0

4 species are recommended also in the southern, and northern zones, but not recommended for the central area. Such species can be considered as it is fully-spectral on adaptation to factors of temperature condition. The insufficient efficiency of their adaptation in Zhezkazgan can be defined by limitation of natural moisture providing (NMP=0,3). Insufficient success of an introduction of species in Zhezkazgan has determined ignoring by them to the settlement of Zhairem. If this logic is right, then the analyzed species should be considered as full-spectral on temperature condition, but «limited by deficiency of moisture security» (LDM).

6 species are recommended only in Bakanas, and therefore their ecological specialization in the Central Kazakhstan «southern» (S). Such species correspond to the 3rd category of winter hardiness of A. Reder. «FS» and «LDM» ignore differentiation of the environment on the 3rd and 2nd categories of conditions of a re-wintering of A. Reder. The discussed species on expected resettlement of A. Reder are lower and lower, are characterized by the 2nd category of winter hardiness.

4 species are recommended only for the central introduction area of the region. We will define such species as «central» (C). They correspond to the 2nd category of winter hardiness of A. Reder with an additional condition of level of the State Customs Committee lower than 0,8.

7 species are recommended both in central and in northern introduction zones of the Central Kazakhstan. Therefore they can be defined as «North-Central» (NC).

The maximum number of species (37), are recommended only for a northern introduction zone of the Central Kazakhstan. Their specificity are higher insistence to atmospheric moisture providing, than it takes place in the southern and central areas.

The groups of ecological plasticity or group of the recommended cultivation area of species of trees allocated for the Central Kazakhstan are the bright evidence of limitation of climatic one-factorial models of introduction division into districts. Where division into districts on gradation of an average long-term annual minimum of temperature marks out only two gradation of conditions of the habitat and, respectively, potentially only two categories of ecological plasticity of plants, at trees are implemented six categories of ecological plasticity. Two of such categories («FS» with «LDM») «ignore» inter zonal boundary of A. Reder [12] of an average long-term annual minimum of temperature — 35 ºС. («S», «C», «N») this ecological boundary is essential to other 4 groups of «ecological plasticity», but can be complemented with special gradation of other climatic indicators («C», «N»).

Having differentiated groups of ecological plasticity of species of trees in the Central Kazakhstan it is possible to return to a question of formation of the recommendation temporary introduction points. In recommendations for Ekibastuz «FS» — 9 species, «LDM» — 2 species, «SC» — 7 species and «C» only one species. It is obvious that at short-term the introduction tests for a quality assurance of recommendations, they joined mainly, views with broad ecological plasticity. In the reviewed example of the Ekibastuz city it makes 93,3 %. In recommendations for Zhairem widely — plastic species make 100,0 %.

In a northern introduction zone less than 24 % of number of species of the trees which were recommended for Karaganda, also are recommended for Ekibastuz. Most likely, it has been connected with the fact that introduction tests of plants in Zhairem and Ekibastuz have been begun after publication of recommendations for Zhezkazgan and Karaganda therefore long-term experience has been insufficiently considered when were gardening these settlements.

According to the preliminary analysis for Zhezkazgan region among the recommended species prevail Asian and Eurasian (60,2 %), and 68,2 % from them have the Kazakhstan elements of area. About a quarter (26,0 %) among the recommended species of trees are made by natives of North America. Rub above the discussed areal groups completely provide with species four groups of ecological plasticity in general in the Central Kazakhstan («FS», «LDM», «S» and «C»). At «FS» species prevail North American (46,7 %) and Eurasian (40,0 %), in «LDM», «S» and «NC» groups — the Eurasian species are absent. In the LDM group there is a parity of Asian and North American species. In groups «S» and «NC» Asian species prevail.

Groups of ecological plasticity of «NC» differ in special areal characteristics of species and «C». In the NC group the Eurasian species (71,4 %) in the presence of Asian and European prevail (on 14,3 %). All types of this group of ecological plasticity have the Kazakhstan elements of areas. At the types recommended only for a northern introduction zone of the Central Kazakhstan («C») Asians (37,9 %) dominate. They are followed by North Americans (21,6 %), Afro-Asian and Europeans (on 16,2 %). Besides, in this group are reckoned with Afro-Asian (5,4 %) and Afro-European (2,7 %) areas.

The similar preliminary analysis for attraction is carried out to an introduction also by species of bushes (Table 2).

Table 2

Number and ecological plasticity of bushes species recommended for gardening

Group of ecological plasticity in the Central Kazakhstan	Introduction zones of the Central Kazakhstan					Total species in group of ecological plasticity
	Southern	Central		Northern		
	Bakanas	Zhezkazgan	Zhairem	Ekibastuz	Karaganda	
Fully-spectral (FS)	15 / 100,0	15 / 100,0	13 / 86,7	11 / 73,3	15 / 100,0	15 / 100,0
FS by temperature regime, it is limited to deficiency of moisture (LDM)	4 / 100,0	– / 0,0	– / 0,0	1 / 25,0	4 / 100,0	4 / 100,0
Southern (S)	7 / 100,0	– / 0,0	– / 0,0	– / 0,0	– / 0,0	7 / 100,0
Central (C)	4 / 100,0	3 / 75,0	2 / 25,0	– / 0,0	– / 0,0	4 / 100,0
Southern-Central (SC)	– / 0,0	25 / 83,3	15 / 50,0	– / 0,0	– / 0,0	30 / 100,0
Northern (N)	– / 0,0	30 / 100,0	18 / 160,0	5 / 16,7	28 / 93,3	30 / 100,0
Total:	– / 0,0	– / 0,0	– / 0,0	14 / 25,0	51 / 191,0	56 / 100,0
Share from the total number of species of the region,%	30	73	48	31	98	146
Fully-spectral (FS)	20,5	50,0	329	21,2	67,1	100,0

For only 4 regions 146 species of bushes, including Bakanas — 30, Zhezkazgan — 73, Zhairem — 48, Ekibastuz — 31, Karaganda — 98 species are recommended. For bushes the same are characteristic, as of trees of group of ecological plasticity in the region («FS», «LDM», «S», «C», «NC», «N») and one more additional group. Her feature is that the types making it are recommended both for southern, and for central the introduction zones of the Central Kazakhstan. Thereby, according to characteristics of an average long-term annual minimum of air temperature the group represents a complex of the 3rd and 2nd categories of winter hardiness of A. Reder. We will define this group of ecological plasticity as «central southern» (CS).

According to characteristics of areas recommended to the Central Kazakhstan of bushes the common and distinctive features concerning trees reckon. As well as among the recommended trees, among the recommended bushes species of Asian, Eurasian origin (70,6 %) prevail, and the share among them of species with the Kazakhstan elements of an area is high (59,9 %). The share of North American species among bushes (18,9 %) is lower, than among trees.

Bushes have much less also a role of North American species in formation of groups of broad ecological plasticity. It is rather essential (50 %) only in the LDM group. In other groups of broad ecological plasticity («SC» and «N») the priority belongs to Asian species (75 % and 60 % respectively). In group it is fully-spectral species («FS») Eurasian (33,3 %), Asians (26,7 %), Europeans and North Americans are presented (on 20 %). As well as at trees, at bushes the maximum variety the areas characteristics are peculiar to group of ecological plasticity «C».

At high similarity of structure of groups of ecological plasticity of introduced species in the Central Kazakhstan, areas components of such groups for trees and bushes significantly differ, excepting domination of species with an Asian area.

90 species of wood plants in the territory of Zhezkazgan botanical garden have been analyzed (see Fig.).

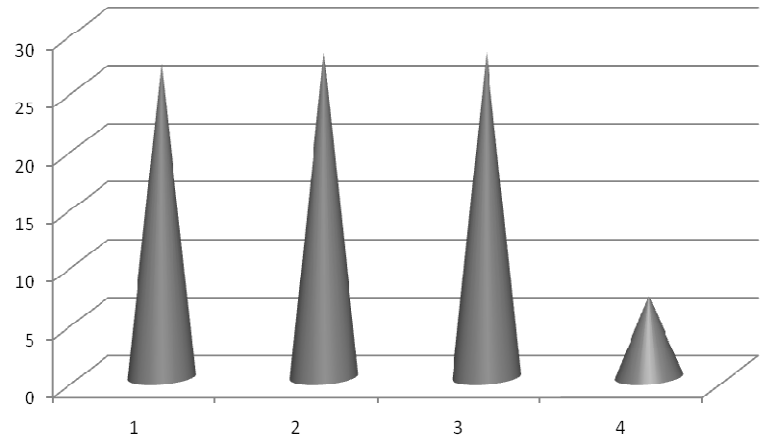
Following the results of researches all trees have been broken into 4 categories:

1 — very perspective plants which can be applied widely in mass gardening of settlements of Zhezkazgan region;

2 — perspective, that is species which can be used for landing by the square and when gardening a park zone;

3 — unpromising, suitable for creation of separate compositions and in private gardening;

4 — not perspective, that is the species demanding careful leaving and suitable only in private gardening and green construction.



1 — very perspective species; *2* — perspective species; *3* — unpromising species; *4* — not perspective species

Figure. Ranking specis by degree of perspectivity in the condition of Zhezkazgan region

To the first category 27 species of trees, have been carried to the second and third — on 28 species, to the fourth — 7 species.

Conclusion

Experience of plants introduction in the Central Kazakhstan is analyzed. Modification of introduction division into districts of the region and classification of groups of ecological plasticity of species of introduced species in the region is offered. The validity and efficiency of these developments is confirmed with the analysis of use of plants in green construction of the Central Kazakhstan. The principles of introduction mobilization of plants to the Central Kazakhstan are developed.

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Г.Т. Максутбекова, М.К. Ахматов

Жезқазған өндірістік аймағындағы бұталы-ағашты өсімдіктер интродукциясының тиімділігін бағалау

Мақалада Орталық Қазақстандағы интродукция тәжірибесі жан-жақты бағаланды. Белгіленген аймақ интродукциясының модификациясы және аймақтағы түрлердің экологиялық сипаттағы классификациялық топтары ұсынылды. Талдау нәтижелерінің негізділігі мен тиімділігі Орталық Қазақстандағы жасыл өсімдіктер құрылысында пайдаланылып, расталды. Орталық Қазақстанда өсімдіктерді интродукциялық мобилизациялау тәсілдері әзірленді. Зерттеу қорытындысы бойынша барлық ағаштектестер 4 топқа жіктелді: 1) Жезқазған өңірінің елді мекендерін жаппай көгалдандыру саласында кеңінен қолдануға болатын өте перспективалық өсімдіктер; 2) саябақ отырғызуға және көгалдандыруға пайдалануға болатын перспективалық түрлер; 3) аз перспективалық, жеке өсімдіктер композициялары мен көгалдандыру жасау үшін жарамды түрлер; 4) тек жеке бау-бақша және жасыл құрылыста жарамды, аса күтімді қажет ететін, болашағы жоқ өсімдіктер тобы.

Кілт сөздер: интродукция тиімділігі, бұталы-ағашты өсімдіктер, интродукция, Жезқазған өңірі.

Г.Т. Максутбекова, М.К. Ахматов

Оценка успешности интродукции древесно-кустарниковых растений в условиях Жезказганского промышленного региона

В статье проанализирован опыт интродукции растений в Центральном Казахстане. Предложены модификация интродукционного районирования региона и классификация групп экологической пластичности видов интродуцентов в регионе. Обоснованность и эффективность этих разработок подтверждены анализом использования растений в зеленом строительстве Центрального Казахстана. Разработаны принципы интродукционной мобилизации растений в Центральный Казахстан. По итогам исследований все деревья были разбиты на 4 категории: 1 — весьма перспективные растения, которые можно широко применять в массовом озеленении населенных пунктов Жезказганского региона; 2 — перспективные виды, которые можно использовать для посадки скверов и при озеленении парковой зоны; 3 — малоперспективные, пригодные для создания отдельных композиций и в частном озеленении; 4 — неперспективные, требующие тщательного ухода и пригодные только в частном садоводстве и зеленом строительстве.

Ключевые слова: успешность интродукции, древесно-кустарниковые растения, интродукция, Жезказган.

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