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Diagnosics of introduction value of herbs of natural flora in the conditions of Mangystau

At the article the results of assessment of introductive value of herbs of natural flora of Mangyshlak for planting in the Mangyshlak experimental botanical garden are presented. Valued scale included 24 diagnostic signs separated into 4 groups: biological stability (hot-, dry-, winter-stability, resistant to disease and pest, substrate requirement), decorative properties and habitus (general decorative properties, length and esthetic properties of flowering and fructification), reproductive ability (seed or vegetative reproduction), practical-biological and scientific meaning (using as decorative, phytomeliorative, food, medical or technical plant). Indexes of value of herbs varied from «reduced» (V class, 45 balls) till «very high» (IX class, 83 balls). The maximum ball belongs to *Tamarix ramisissimum*, the minimum — *Solanum persicum*. The assessment of introduction value of 127 species of herbs of natural flora of Mangystau region is developed. The results are shown that «extremely low» introduction value was diagnosed 1.6 % studied species; «very low» — 3.9 %; «low» — 8.7 %; «reduced» — 15.7 %; «higher» — 22.8 %; «high» — 13.4 % и «very high» — 7.1 %. On the base of diagnostic of introduction value of herbs of natural flora is producing the collection of herbs.

Keywords: introduction, herb, natural flora, Mangyshlak experimental botanical garden, value, diagnostics.

Introduction

The severe climatic conditions of the desert of Mangystau [1, 2] differing in a climate extra-arid, salinity, a low-profile and poverty of soils and tension of the wind mode cause very low introduction selection of plants [3]. Therefore from the very beginning of botanical development of the region, the problem of diagnostics of prospects of plants for an introduction for the purpose of improvement of quality and efficiency of creation of green and phyto meliorative plantings and also reduction of costs of primary tests of introduced species very much is particularly acute. The available developments on the matter are generally intended for forest and forest-steppe natural zones [4–7], and is not suitable for droughty climate and adverse soil and meliorative conditions of the region of researches. The Mangyshlak experimental botanical garden (further MEBG) has set the task of drawing up a regional scale of determination of introduction value of plants which would consider the greatest possible quantity of the factors, properties and features connected with growth, development and application of introduced species by the person in the activity and also reaction of a vegetable organism to features of the desert habitat.

The purpose of the real research was to carry out diagnostics of introduction value of herbs of a natural zone of Mangystau Region on the developed regional scale.

Methodology

Object of a research were the introduced herbs of natural flora of Mangystau. When developing a rating scale on the introduction value of herbs were taken into account to feature of climatic conditions of the desert of Mangystau, experience of introduction researches in the region, results of the analysis of mean annual bioecological properties of collection types and approbation of techniques of determination of viability and prospects of plants, widespread in other botanical centers [8–12]. The rating scale included 24 diagnostic signs broken into 4 groups: biological stability, decorative properties and habitus, reproductive ability, economic and biological and scientific value.

The tolerance of introduced species to conditions of the habitat develops in a scale as their score dry-, salty-, winter-, phytophagy- and gas resistance and insistence to fertility of the soil. At assessment decorative habitus properties growth form, the general decorative effect of a vegetative part, ability to leaf fall, abundance, duration and esthetics of blossoming and fructification is considered. The reproductive ability is diagnosed on the basis of accounting of success of renewal of plants in the conditions of culture by seed and vegetative ways. When determining economic and biological and scientific value the possibility of their use in the greening, phyto meliorative, food, fodder, medicinal and technical purposes is taken into account and

also the phyto security status is considered. The scale is 100-mark, ranged on 10 classes (groups) of the value (Table 1).

Table 1

Distribution of plants into classes and indexes of value taking into account the gained sum of estimated points

Class	Sum of points	Index of value
I	0–10	Not being value
II	11–20	Extremely low
III	21–30	Very low
IV	31–40	Low
V	41–50	Reduced
VI	51–60	Average
VII	61–70	Higher
VIII	71–80	High
IX	81–90	Very high
X	91–100	Maximum high (etalon)

Results and their discussion

At the beginning on the example of medicinal and valuable plants of local flora 17 taxons from 14 botanical genera and 12 families of different degree of stability, forms of growth, systematic and geographical accessory (Table 2) have been attracted to approbation of a scale.

Table 2

Results of diagnostics of introduction value of some herbs of natural flora of Mangystau on a regional complex scale, in points

Species	Sum points by groups of signs				Total points	Class of value	Index of value
	Biological stability	Decorative and habitus peculiarities	Reproductive ability	Practical-biological and scientific importance			
<i>Artemisia terraealbae</i>	45	8	4	15	7	VIII	High
<i>Salsola richteri</i>	45	8	4	15	72	VIII	High
<i>Ephedra distachya</i>	37	13	7	20	77	VIII	High
<i>Ephedra strobilacea</i>	40	13	7	20	80	VIII	High
<i>Elaeagnus angustifolia</i>	46	9	7	14	76	VIII	High
<i>Alchagi pseudoalchagi</i>	37	11	6	16	70	VII	Higher
<i>Halimodendron halodendron</i>	46	8	7	12	72	VIII	High
<i>Nitraria schoberi</i>	42	9	7	15	73	VIII	High
<i>Nitraria sibirica</i>	37	8	7	10	62	VII	Higher
<i>Malacocarpus crithmifolius</i>	36	10	9	20	75	VIII	High
<i>Peganum harmala</i>	38	8	6	17	69	VII	Higher
<i>Calligonum leucocladum</i>	42	6	6	17	71	VIII	High
<i>Crataegus ambigua</i>	33	17	7	20	73	VIII	High
<i>Salix alba</i>	35	9	5	12	61	VII	Higher
<i>Solanum persicum</i>	25	4	6	10	45	V	Reduced
<i>Tamarix ramosissima</i>	48	12	5	18	83	IX	Very high

The index of value of herbs defined by a scale varies in rather wide limits — from «reduced» (the V class, 45 points) to «very high» (the IX class, 83 points). However, the majority of species (58.8 %), owing to the high biological stability caused by belonging to local flora and presence of many useful (not only medicinal) qualities, belongs to group with «high» prospects (the VIII class, 71–80 points). They are *Artemisia terraealbae*, *Salsola richteri*, *Ephedra distachya* and *strobilacea*, *Elaeagnus angustifolia*, *Halimodendron halodendron*, *Nitraria schoberi*, *Malococarpus crithmifolius*, *Calligonum leucocladum* and *Crataegus ambigua*.

The maximum number of points (83) was gained by *Tamarix ramosissima* due to high biological stability, ability to vegetative reproduction and value for gardening and phytomelioration.

Elaeagnus oxycarpa has the greatest number of points of stability among other plants, but considerably loses to *Tamarix ramosissima* by decorative effect and opportunities of practical application (only 76). *Malacocarpus crithmifolius* concedes to *Elaeagnus oxycarpa* by score (75) because of smaller stability a little though its practical and scientific value as an endemic of Mangystau is very high. Thanks to the greening and phytosecurity importance the considerable number of points gathers *Crataegus ambigua*, included in the Red List of Kazakhstan (73, the VIII class). The number of points, almost identical with its, estimates prospects of *Nitraria sibirica* (73) and *Halimodendron halodendron* (72). On the sum of estimated points come very close to them *Artemisia terrae-albae* (72) and *Alhagi pseudoalhagi* (70), generally due to very high stability and fodder value. Widespread green plantings of the region is *Salix alba*, which has high tolerance to a local environment and for green construction in arid regions, loses points mainly because of not really high esthetics of a habitus (61, the VII class, «higher»).

The low estimates prospects of an annual grassy plant of *Solanum persicum* (the V class, 45) of which low points of indicators of biological stability are characteristic. Other species, despite the increased tolerance to desert conditions, considerably lose points because of low general decorative effect, economic-biological and scientific value and therefore get into group of the «higher» introduction value: *Nitraria schoberi*, *Peganum harmala* and *Polygonum aviculare*.

On materials of statistical processing of materials of researches, the score, average for all types, is 70.4, that is estimated «high» (the VIII class). On it, obviously, also their belonging to group of officinal introduced species is reflected in a certain measure on what the regional scale provides addition from 2 to 7 points. In selection the greatest variation is noted for score on group of signs «Decorative habitus peculiarities» (31.3 %). In the others the group coefficient of a variation makes 16.9–22.0 %. It is interesting that at the general assessment of group of indicators kind of repay in the sum variability of estimated points to 12.5 % (Table 3).

Table 3

The main statisticians of scores on groups of signs for herbs of Mangystau, in points

Groups of signs	X	S	C _v , %	S _x	p, %	X _{min}	X _{max}	R _v
Biological stability	38.8	6.5	16.9	1.6	4.1	25	48	23
Decorative peculiarities and habitus	9.6	3.0	31.3	0.7	7.6	4	17	13
Reproductive ability	6.4	1.3	20.8	0.3	5.0	4	9	5
Practical-biological and scientific importance	15.9	3.5	22.0	0.9	5.3	10	20	10
General assessment	70.4	8.8	12.5	2.1	3.0	45	83	38

After working off and approbation of the program of a regional scale diagnostics of introduction value of 127 herbs of natural flora of Mangyshlak is performed (Table 4).

Table 4

Assessment of diagnostic value of herbs of the natural flora of Mangyshlak

Latin name	Assessment	Latin name	Assessment
1	2	3	4
<i>Acanthophyllum borszczowii</i>	Valuable	<i>Acanthophyllum pungens</i>	Valuable
<i>Alhagi persarum</i>	Valuable	<i>Alhagi pseudoalhagi</i>	Valuable
<i>Anabasis aphylla</i>	Invaluable	<i>Anabasis bracteolate</i>	Invaluable
<i>Anabasis salsa</i>	Valuable	<i>Andrachne rotundifolia</i>	Invaluable
<i>Argusia sibirica</i>	Valuable	<i>Artemisia lessingiana</i>	Valuable
<i>Artemisia austriaca</i>	Valuable	<i>Artemisia lerceana</i>	Valuable
<i>Artemisia santolina</i>	Valuable	<i>Artemisia scoparia</i>	Valuable
<i>Artemisia terrae-albae</i>	Valuable	<i>Asperuga procumbens</i>	Valuable
<i>Astragalus filicaulis</i>	Valuable	<i>Astragalus flexus</i>	Valuable
<i>Astragalus onobrychis</i>	Valuable	<i>Atriplex tatarica</i>	Valuable
<i>Bieneria cycloptera</i>	Invaluable	<i>Camelina microcarpa</i>	Valuable
<i>Camphorosma lessingii</i>	Valuable	<i>Capparis herbaceae</i>	Valuable
<i>Cardaria draba</i>	Valuable	<i>Centarium pulchellum</i>	Valuable

Continuation of Table 4

1	2	3	4
<i>Ceratocarpus arenarius</i>	Invaluable	<i>Ceratocarpus utriculosus</i>	Invaluable
<i>Ceratocephala falcata</i>	Valuable	<i>Chenopodium album</i>	Invaluable
<i>Chenopodium botrys</i>	Valuable	<i>Chondrilla juncea</i>	Valuable
<i>Chrozophora gracilis</i>	Valuable	<i>Cichorium intybus</i>	Invaluable
<i>Cirsium vulgare</i>	Valuable	<i>Cistanche salsa</i>	Very valuable
<i>Clematis orientalis</i>	Invaluable	<i>Convolvulus arvensis</i>	Valuable
<i>Cystopteris fragilis</i>	Valuable	<i>Descurainia sophia</i>	Valuable
<i>Diarthron vesiculosum</i>	Invaluable	<i>Dodartia orientalis</i>	Invaluable
<i>Dryopteris filix-mas</i>	Invaluable	<i>Echinops ritro</i>	Invaluable
<i>Elaeagnus angustifolia</i>	Valuable	<i>Elaeagnus oxycarpa</i>	Valuable
<i>Ephedra distachya</i>	Valuable	<i>Equisetum ramosissimum</i>	Valuable
<i>Euphorbia seguieriana</i>	Invaluable	<i>Euphorbia turczaninovii</i>	Invaluable
<i>Euphorbia falcata</i>	Invaluable	<i>Ferula foetida</i>	Valuable
<i>Fumaria parviflora</i>	Invaluable	<i>Fumaria vaillantii</i>	Valuable
<i>Galium aparine L.</i>	Valuable	<i>Galium ruthenicum</i>	Valuable
<i>Galium humifusum</i>	Valuable	<i>Galium spurium</i>	Invaluable
<i>Galium verum</i>	Valuable	<i>Glaucium corniculatum</i>	Valuable
<i>Glycyrrhiza korshinskyi</i>	Valuable	<i>Glycyrrhiza aspera</i>	Valuable
<i>Glycyrrhiza glabra</i>	Valuable	<i>Gypsophila perfoliata</i>	Valuable
<i>Halimodendron halodendron</i>	Invaluable	<i>Haplophyllum versicolor</i>	Valuable
<i>Hyoscyamus albus</i>	Valuable	<i>Hyoscyamus niger</i>	Valuable
<i>Hypocoum parviflorum</i>	Valuable	<i>Ixiolirion tataricum</i>	Valuable
<i>Kochia prostrata</i>	Valuable	<i>Lepidium latifolium</i>	Valuable
<i>Lepidium ruderales</i>	Valuable	<i>Limonium caspium</i>	Invaluable
<i>Lycium ruthenicum</i>	Valuable	<i>Malva neglecta</i>	Invaluable
<i>Malva pusilla</i>	Valuable	<i>Marrubium vulgare</i>	Valuable
<i>Medicago sativa</i>	Valuable	<i>Melilotus albus</i>	Valuable
<i>Melilotus officinalis</i>	Valuable	<i>Mentha longifolia</i>	Valuable
<i>Microcephala lamellata</i>	Invaluable	<i>Morus alba</i>	Valuable
<i>Nanophyton erinaceum</i>	Valuable	<i>Nepeta cataria</i>	Valuable
<i>Nitraria schoberi</i>	Valuable	<i>Nitraria sibirica</i>	Valuable
<i>Papaver pavonium</i>	Invaluable	<i>Peganum harmala</i>	Valuable
<i>Plantago lanceolata</i>	Valuable	<i>Polygonum minus</i>	Valuable
<i>Potentilla supina</i>	Invaluable	<i>Ranunculus sceleratus</i>	Valuable
<i>Rheum tataricum</i>	Valuable	<i>Roemeria hybrida</i>	Valuable
<i>Roemeria refracta</i>	Valuable	<i>Rosa laxa</i>	Invaluable
<i>Rubus caesius</i>	Valuable	<i>Rumex crispus</i>	Valuable
<i>Salicornia europaea</i>	Valuable	<i>Salix alba</i>	Valuable
<i>Salsola richteri</i>	Valuable	<i>Sisymbrium loeselii</i>	Valuable
<i>Solanum persicum</i>	Valuable	<i>Spergularia maritima</i>	Valuable
<i>Spergularia rubra</i>	Valuable	<i>Spergularia segetalis</i>	Valuable
<i>Stellaria media</i>	Valuable	<i>Suaeda physophora</i>	Invaluable
<i>Syrenia siliculosa</i>	Valuable	<i>Tamarix ramosissima</i>	Valuable
<i>Tamarix meyeri</i>	Invaluable	<i>Tamarix laxa</i>	Invaluable
<i>Teucrium polium</i>	Invaluable	<i>Thalictrum isopyroides</i>	Very valuable
<i>Tribulus terrestris</i>	Valuable	<i>Trifolium fragiferum</i>	Valuable
<i>Verbascum blattaria</i>	Valuable	<i>Verbascum lychnitis</i>	Invaluable
<i>Verbascum phoeniceum</i>	Invaluable	<i>Verbascum songaricum</i>	Valuable
<i>Verbascum thapsus</i>	Invaluable	<i>Veronica anagallis-aquatica</i>	Valuable
<i>Veronica persica</i>	Valuable	<i>Ziziphora tenuior</i>	Valuable

Apparently according to Table 5, distribution of taxons on classes looks almost symmetrically rather «average» index of which 26.8 % of examinees of plants are the share. «Extremely low» it is diagnosed for 1.6 % of the considered species; «very low» — 3.9 %; «low» — 8.7 %; «reduced» — 15.7 %; «higher» — 22.8 %; «high» — 13.4 % and «very high» — 7.1 %.

Distribution of herbs on classes and indexes of introduction value

Class and indexes of value and estimated scores	Total	
	Piece	%
I — not being value (0–10)	0	0.0
II — extremely low (11–20)	2	1.6
III — very low (21–30)	5	3.9
IV — low (31–40)	11	8.7
V — lower (41–50)	20	15.7
VI — average (51–60)	34	26.8
VII — higher (61–70)	29	22.8
VIII — high (71–80)	17	13.4
IX — very low (81–90)	9	7.1
X — maximum high (etalon) (91–100)	0	0.0
Total:	127	100.0

Thus, the complex scale of diagnostics of introduction value developed in MEBG allows to conduct systematically researches on creation of a collection of herbs of local flora, selecting mainly views with high and very high biological stability.

Researches are executed within program and target financing «Development of scientific and practical and computer and information bases of creation of landscape and collection and landscape gardening plantings in the desert zone of Mangystau for preservation and rational use of a biodiversity of plants».

References

- 1 Джаналиева К.М. Физическая география Республики Казахстан / К.М. Джаналиева, Т.И. Будникова, Е.Н. Веселов и др. — Алматы: Қазақ ун-ті, 1998. — 266 с.
- 2 Сафронова И.Н. Пустыни Мангышлака (Очерк растительности) // Тр. Ботанического ин-та им. В.Л. Комарова РАН. — СПб., 1996. — Вып. 18. — 212 с.
- 3 Проблемы мелиорации почв, озеленения и сельского хозяйства // Освоение Мангышлака. — Шевченко, 1976. — С. 25–36.
- 4 Нашенова Г.З. Культивируемые лекарственные растения аридной зоны Центрального и Юго-Восточного Казахстана / Г.З. Нашенова, М.Ю. Ишмуратова, Ж.Б. Нашенов, Г.А. Денгельбаева, Г.Т. Куньпияева. — Жезказган-Алматы: Ер Мұра, 2011. — 117 с.
- 5 Мухитдинов Н.М. Лекарственные растения / Н.М. Мухитдинов, Г.Н. Паршина. — Алматы: Қазақ ун-ті, 2002. — 313 с.
- 6 Изумкулов К.А. Некоторые итоги в выращивании лекарственных трав в условиях Западного Казахстана / К.А. Изумкулов, Н.В. Ищенко // Использование достижений аграрной науки в стабилизации сельскохозяйственного производства Казахстана: сб. науч. тр. — Актобе: Актюб. филиал ЦНТИ, 2003. — С. 198–202.
- 7 Загуменников В.Б. Возделывание лекарственных растений в условиях Западной Сибири и Центрального Казахстана / В.Б. Загуменников, С.Е. Дмитрук, Т.Н. Загуменникова, С.М. Адекенов, А.Ф. Христенко. — Томск: Изд-во НТЛ, 2001. — 196 с.
- 8 Методика интродуцированных исследований в Казахстане. — Алма-Ата, 1987. — 135 с.
- 9 Иманбаева А.А. Коллекции растений Мангышлакского ботанического сада / А.А. Иманбаева, И.Ф. Белозеров, О.Н. Косарева и др. — Алматы: ТОО «Luxe Media Publishing», 2017. — 152 с.
- 10 Русанов Ф.Н. Теория и опыт переселения растений в условия Узбекистана / Ф.Н. Русанов. — Ташкент: Фан, 1974. — 112 с.
- 11 Белозеров И.Ф., Иманбаева А.А. Свидетельство о государственной регистрации прав на объект авторского права программа «DInCeR» (для ЭВМ) за № 2339 от 14 декабря 2015 г. (ИС 003261).
- 12 Куприянов А.Н. Интродукция растений / А.Н. Куприянов. — Кемерово: Кузбассвузиздат, 2004. — 94 с.

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Маңғышлақ табиғи флора жағдайындағы дәрілік өсімдіктердің интродукциялық құндылықтарының диагностикасы

Мақалада Маңғышлақтың эксперименталдық ботаникалық бағында мәдени түрге енгізу үшін Маңғышлақ табиғи флора жағдайындағы дәрілік өсімдіктердің интродукциялық құндылықтарының диагностикасын бағалау нәтижелері келтірілген. Бағалау шкаласы 4 топқа бөлінген 24 диагностикалық белгіні қамтиды: биологиялық тұрақтылық (ыстыққа, құрғақшылыққа, қысқа төзімділігі, аурулар мен зиянкестерге қарсы және субстратқа талабы бойынша тұрақтылығы), сәндік қасиеттері және габитусы (жалпы сәнділігі, гүлдеу ұзақтығы, гүлдеу және жеміс беру эстетикасы), репродуктивті қабілеті (тұқым арқылы немесе вегетативтік жолымен көбеюі), шаруашылық-биологиялық және ғылыми маңызы (сәндік, фитомелиоративтік, тағамдық, дәрілік және техникалық өсімдіктер ретінде пайдалану). Дәрілік түрлердің құндылықтар индексі ең «төмен» (V сыныбы, 45 ұпайдан), «өте жоғары» (IX сынып, 83 ұпайға) дейін ауытқып отырады. Максималды ең жоғары ұпай бұтақты жыңғылда, ал минималды ең төменгісі парсы алқасында болды. Маңғыстау облысы табиғи флорасында кездесетін 127 түрлі дәрілік өсімдіктерінің интродукциялық құндылықтарын бағалау жүзеге асырылды. Ескерілген түрлердегі диагностика нәтижелері көрсеткендей, «аса тым төмен» интродукциялық құндылық 1,6%; «өте төмен» — 3,9%; «төмен» — 8,7%; «төмендеу» — 15,7%; «жоғарылау» — 22,8%; «жоғары» — 13,4%; «өте жоғары» 7,1% болды. Табиғи флора дәрілік өсімдіктерінің интродукциялық құндылықтарын диагностикалау негізінде дәрілік өсімдіктердің коллекцияларын құру жүргізілді.

Кілт сөздер: интродукция, дәрілік өсімдіктер, табиғи флора, Маңғышлақ эксперименталдық ботаникалық бағы, құндылық, диагностика.

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Диагностика интродукционной ценности лекарственных растений природной флоры в условиях Мангышлака

В статье приведены результаты оценки интродукционной ценности лекарственных растений природной флоры Мангышлака для введения в культуру в Мангышлакском экспериментальном ботаническом саду. Оценочная шкала включала 24 диагностических признака, разбитых на 4 группы: биологическая устойчивость (жаро-, засухо-, зимостойкость, устойчивость к болезням и вредителям, требовательность к субстрату), декоративные свойства и габитус (общая декоративность, длительность цветения, эстетичность цветения и плодоношения), репродуктивная способность (размножение семенным или вегетативным путем), хозяйственно-биологическое и научное значение (использование в качестве декоративного, фитомелиоративного, пищевого, лекарственного или технического растения). Индекс ценности лекарственных видов варьирует от «пониженного» (V класс, 45 баллов) до «очень высокого» (IX класс, 83 балла). Максимальный балл получил тамарикс ветвистый, минимальный — паслен персидский. Осуществлена оценка интродукционной ценности 127 видов лекарственных растений природной флоры Мангыстауской области. Результаты показали, что «крайне низкая» интродукционная ценность диагностирована для 1,6% учтенных видов; «очень низкая» — для 3,9%; «низкая» — для 8,7%; «пониженная» — для 15,7%; «повышенная» — для 22,8%; «высокая» — для 13,4% и «очень высокая» — для 7,1%. На основании диагностики интродукционной ценности лекарственных растений природной флоры производится закладка коллекции лекарственных растений.

Ключевые слова: интродукция, лекарственное растение, природная флора, Мангышлакский экспериментальный ботанический сад, ценность, диагностика.

References

- 1 Dzhanalieva, K.M., Budnikova, T.I., & Veselova E.N. et al. (1998). *Fizicheskaia heohrafiia Respubliki Kazakhstan [Physical geography of Republic of Kazakhstan]*. Almaty: Qazaq universiteti [in Russian].
- 2 Saftonova, I.N. (1996). Pustyni Manhyshlaka (Ocherk rastitelnosti) [Deserts of Mangyshlak (review of vegetation). *Trudy Botanicheskoho instituta imeni V.L. Komarova — Herald of V.L. Komarov Botanical institute*, 18, 212 [in Russian].
- 3 Problemy melioratsii pochv, ozeleneniia i selskoho khoziaistva [Problems of soil melioration, green building and agriculture] (1975). *Osvoenie Manhyshlaka — Reclamation of Manhyshlak*, 25–36 [in Russian].
- 4 Nashenova, H.Z., Ishmuratova, M.Yu., Nashenov, Zh.B., Denhelbaeva, H.A., & Kunipiyaeva, H.T. (2011). *Kultiviruemye lekarstvennye rasteniia aridnoi zony Tsentralnoho i Yuho-Vostochnoho Kazakhstana [Cultivated herbs of arid zone of the Central and South-Eastern Kazakhstan]*. Zhezkazhan-Almalybak: Er Mura [in Russian].

- 5 Mukhitdinov, N.M., & Parshina, H.N. (2002). *Lekarstvennye rasteniia [Medicinal herbs]*. Almaty: Qazaq universiteti [in Russian].
- 6 Izumkulov, K.A., & Ishchenko, N.V. (2003). Nekotorye itohi v vyrashchivanii lekarstvennykh trav v usloviakh Zapadnoho Kazakhstana [Some results of cultivation of herbs in the conditions of Western Kazakhstan]. *Ispolzovanie dostizhenii ahrarnoi nauki v stabilizatsii selskokhoziaistvennogo proizvodstva Kazakhstana — Using of achievements of agrarian science for stabilization of agricultural industry of Kazakhstan*. Aktobe: Aktiubinskii filial TsNTI [in Russian].
- 7 Zahumennikov, V.B., Dmitruk, S.E., Zahumennikova, T.N., Adekenov, S.M., & Khristenko, A.F. (2001). *Vozdelyvanie lekarstvennykh rastenii v usloviakh Zapadnoi Sibiri i Tsentralnoho Kazakhstana [Cultivation of herbs in the conditions of the Western Siberia and Central Kazakhstan]*. Tomsk: Publ. NTL [in Russian].
- 8 *Metodika introdutsirovannykh issledovaniy v Kazakhstane [Methodology of introduction investigation in Kazakhstan]*. (1987). Alma-Ata [in Russian].
- 9 Imanbayeva, A.A., Belozеров, I.F., & Kosareva, O.N. et al. (2017). *Kollektzii rastenii Mangyshlaksokho botanicheskoho sada [Collections of plants of Mangyshlak botanical Garden]*. Almaty: Luxe Media Publishing [in Russian].
- 10 Rusanov, F.N. (1974). *Teoriia i opyt pereseleniia rastenii v usloviia Uzbekistana [Theory and experience of resettlement of plants in the conditions of Uzbekistan]*. Tashkent: FAN [in Russian].
- 11 Belozеров, I.F., & Imanbayeva, A.A. (2015). *Svidetelstvo o gosudarstvennoi rehratsii prav na obekt avtorskoho prava prohramma «DInCeR» (dlya EVM) [Certificate of state registration of right for object of copyright for program (for computer)]*. № 2339 (IN 003261) [in Russian].
- 12 Kupriianov, A.N. (2004). *Introduktsiia rastenii [Plant introduction]*. Kemerovo: Kuzbassvuzizdat [in Russian].