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Introduction of woody and shrubby plants of the natural flora of the Western Kazakhstan at the territory of Mangyshlak experimental botanical garden

Results of primary introductory test of 21 species of woody and shrubby plants of natural flora of the Western Kazakhstan in the conditions of Mangyshlak experimental botanical garden are given in article. Selection of introduced species was made from natural habitats of the Mangystau, Atyrau, Aktyubinsk and West Kazakhstan regions. Examining taxa enter into the following ecological groups: xerophytes (5 species), mesophytes (7 species), mesoxerophytes (5 species) and xeromesophytes (4 species). Primary test in culture allowed allocating 3 groups of plants: very steady — 9 taxa; steady — 11 taxa; not steady — 1 taxon. The analysis of economic and useful properties allowed defining that 15 species are suitable as ornamental plants, 10 — as food, 8 — phytomeliorative, 11 — melliferous, 6 — medicinal, 2 — as a stock for reproduction of cultivars. The correlation between ecological group of a taxon and resistance to local climate is not revealed. Species for further introductory test are defined.

Keywords: Mangyshlak experimental botanical garden, primary introduction, woody and shrubby plants, sustainability, ecological groups, practical uses, natural flora.

Introduction

Introduction of plants, as main directions of experimental botany and plant ecology, has not only scientific, public and informative, but also important economic, ecological, economic value. This fact is practical expression of implementation of requirements of articles 9–18 «Conventions on Biological Diversity» and Nagoya protocol (1992) [1].

This problem is particularly acute in arid conditions which differ in poverty of specific structure and a complex of adverse factors for implementation greening, the introduction, selection and phytomeliorative works [2, 3].

The introduction of plants should be carried out by one of the main strategic directions of botanical gardens intensively and in big scales. In world practice it is proved that without scientifically based recommendations attraction the plants which were pleasant to them from districts of former settlements do not always gives a successful outcome. Only at such approach there is possible an implementation of the most probable projection of a successful introduction and selection of the greening range of plants meeting the ecological, esthetic requirements of the alleged region of an introduction.

Local flora has the considerable prospect of use as source of the plants, steady against local climatic conditions, having decorative, medicinal, food, melliferous, meliorative properties.

The purpose of the real research was primary introduction assessment of new woody and shrubby plants of local flora in the conditions of the Mangyshlak experimental botanical garden.

Methodology

Objects of researches were 21 species of woody and shrubby plants of the collection fund of Mangyshlak experimental botanical garden (further MEBG) attracted from natural flora of the Western Kazakhstan (Table 1).

Selection of initial material from the nature was made on floristic regions of the Western Kazakhstan: Caspian, Bukeev, Emba, Aktobe, Mangystau, Ustyurt.

In the conditions of the MEBG collection for the selected taxa investigated primary introduction questions: phenology [4], some biometric indicators [5], rhythms of seasonal growth and development [6, 7]. For all introduced species defined ecological group in relation to conditions of moistening [8] and a vital form [9]; and also the prospects of practical application of species in economic activity [10].

Taxonomic list of testing woody and shrubby plants

No.	Family	Genus	Species
1	Fabaceae	<i>Amygdalus</i>	<i>A.nana</i>
2		<i>Astragalus</i>	<i>A.ammодendron</i>
3		<i>Ammодendron</i>	<i>A.eichwaldii</i>
4	Polygonaceae	<i>Atraphaxis</i>	<i>A.replicata</i>
5	Rosaceae	<i>Crataegus</i>	<i>C.sanguinae</i>
6		<i>Malus</i>	<i>M.sieversiana</i>
7			<i>M.baccata</i>
8		<i>Padus</i>	<i>P.racemosa</i>
9		<i>Prunus</i>	<i>P.spinosa</i>
10		<i>Rosa</i>	<i>R.laxa</i>
11			<i>R.glabrifolia</i>
12			<i>R.caesius</i>
13			<i>Rubus</i>
14		<i>Spiraea</i>	<i>S.hypericifolia</i>
15	Betulaceae	<i>Corylus</i>	<i>C.avellana</i>
16	Salicaceae	<i>Populus</i>	<i>P.tremula</i>
17			<i>P.alba</i>
18			<i>P.diversifolia</i>
19			<i>P.nigra</i>
20		<i>Salix</i>	<i>S.caprea</i>
21	Glossulariaceae	<i>Ribes</i>	<i>R.aureum</i>

Results and their discussion

The introduction of wood plants is an important part of all introduction activity. This question in a treeless arid zone is especially relevant. The analysis shows that in droughty zones of Kazakhstan wood plants from Western Europe are successfully cultivated, a temperate climate of North America, Siberia and East Asia [11].

As a result of forwarding researches on the territory of the Western Kazakhstan (Mangystau, West Kazakhstan, Atyrau and Aktyubinsk areas) in 2016–2018 21 species were attracted in an introduction experiment. Their short characteristic is given below:

1) *Amygdalus nana* is an undersized bush, mesoxerophyte. It is involved with landing material and seeds from the mountain Big Ichka (West Kazakhstan region). The beginning of vegetation falls on the 2nd decade of March, full expansion of leaves comes to the end of March; budding at the end of March; blossoming — in 1–2 decades of April. Infructescence in culture was not observed. In the territory of MEBG plants reached height of 30–35 cm. A state in culture is good.

2) *Astragalus ammodendron* is a bush, a semi-bush, xerophyte. It is involved with landing material from Tuyesu sands (Mangystau Region). The beginning of vegetation at a species is noted in the 3rd decade of March; isolation of leaves falls on 1–3 decades of April. The beginning of budding is recorded in the 20th of April; blossoming since the end of April until the 1st decade of May. The fructification is dragged out — from the 1st decade of May to 1st decade of June. Growth of shoots comes from the end of April till the second half of June. In culture height of 50–60 cm reaches. The state is satisfactory.

3) *Atraphaxis replicata* is a bush of the average sizes, xerophytes. The Western Karatau (Mangystau region) is involved in culture from the ridge. The beginning of vegetation is noted in the 1st decade of March, isolation and expansion of leaves from the middle until the end of March. Budding is revealed in the middle of April, blossoming — since the end of April to the 3rd decade of May. Fructification is moderate, happens from 1 decade of May until the end of July. Growth of shoots comes to an end in the middle of June. A state in a collection is very good. Height of a plant is from 70 to 90 cm.

4) *Crataegus sanguinea* is a small shady tree or large bush. It is involved with seed material from a natural reservation «Oak grove» (West Kazakhstan region). Young plants begin vegetation in the 2nd decade of March, isolation and expansion of leaves — since the end of March to the middle of April. Plants in culture have height of 10–20 cm therefore did not enter a generative phase yet. A state in culture is satisfactory.

5) *Corylus avellana* is a bush, rarer is a small tree, mesophyte. It is involved from the territory of a natural reservation «Oak grove» (West Kazakhstan region) in the form of live plants. The beginning of vegetation is recorded from the 2nd decade of March, growth and isolation of leaves since the end of March on the middle of April. As in culture there are young individuals, the phase of budding and blossoming was not observed. The plant suffers from dryness of atmospheric air, in the middle of July solar burns of leaves are noted. Height of individuals is up to 50–55 cm.

6) *Padus racemosa* is a bush; rarer is a small tree, mesophyte. It is involved in culture from forests in the neighborhood of the mountain Big Ichka (West Kazakhstan region) in the form of young live plants. The beginning of vegetation of a species falls on 2–3 decade of March, expansion of leaves is since the end of March to the middle of April. Young individuals reach height of 50–70 cm, did not reach the generative period yet. Conditions of individuals are satisfactory.

7) *Populus tremula* is a large tree, mesoxerophyte. It is involved with small plants and shanks from the valley of the Bykovka River (West Kazakhstan region). The beginning of vegetation of individuals is recorded in the 1st decade of March, isolation of leaves begins in the middle of March, and growth finishes in the 1st decade of April. Due to the young age of plants, the aspen did not enter the generative period. Condition of individuals is satisfactory; height is 30–45 cm.

8) *Populus alba* is a large tree, mesoxerophyte. The species is involved with shanks from the valley of the Bykovka River (West Kazakhstan region). Shanks took roots; small gain of 4–5 cm is noted. The general height was 15–20 cm. The state is satisfactory.

9) *Populus nigra* is a large shady tree, a xeromesophyte. Plants are involved in culture in the form of shanks from Petrovsky sands and from vicinities of the natural reservation «the Sadovsky lake» (West Kazakhstan region). As well as the previous species, in a collection of an individual are presented in the form of the small taken roots plants up to 30–35 cm high. The general state in culture is satisfactory.

10) *Ammodendron eichwaldii* is a small tree or a bush. It is involved with live plants and seeds from sands Sam (Mangystau region), xerophyte. The beginning of vegetation is noted in the 1st decade of April; expansion of leaves since the 3rd decade of April until the end of May. The phase of budding is recorded in the 1st decade of May, the beginning of blossoming — in the 2nd decade of May, and the end — the 3rd decade of May. Fructification plentiful and stretched; is noted since the end of May till the middle of July. Growth of shoots comes to an end at the end of June. A condition of a plant in culture is good.

11) *Ribes aureum* is a bush, a xeromesophyte. It is involved with live plants from a flood plain of the Urals River (West Kazakhstan region). The beginning of vegetation fell on the middle of March; isolation of leaves is recorded from the second half of March on the 3rd decade of April. Budding fell on the middle of April, blossoming from the 2nd half until the end of April. Fructification is plentiful; since the end of April to the middle of June. Growth of shoots came to the end till middle of April. The state in culture is very good; height of plants is 120–140 cm.

12) *Rosa laxa* is a bush, mesoxerophyte. It is involved with live plants and shanks from vicinities of the Lake Inder (Atyrau region). In culture vegetation begins in the the 1st decade of March, isolation of leaves begins in the 2nd decade of March and end in the 1st decade of May. Budding begins in the 1st decade of May, finishes in the 3rd decade of May. Blossoming happens from the middle until the end of May. Fructification maturing of fruits is recorded — from the end of May till the end of August. Plants in culture are steady; states are very good. Height is up to 150 cm.

13) *Rosa glabrifolia* is a prickly bush, a xeromesophyte. It is attracted with root young growth and shanks from gorges in the neighborhood of the settlement of Beyneu (Mangystau region). The beginning of vegetation falls on the 1 decade of March, isolation of leaves from the middle of March prior to the beginning of April. Budding is recorded in the 1st decade of May, blossoming from the middle until the end of May. Fructification is weak; it is noted since the beginning of June prior to the beginning of September. The state in culture is satisfactory; height of individuals is 100–120 cm.

14) *Salix caprea* is the high, actively branching bush, mesophyte. It is involved by shanks from a flood plain of the Utva River (West Kazakhstan region). On a collection rooting of the brought shanks is noted. The beginning of vegetation is recorded at the beginning of the 2nd decade of March; isolation of leaves — since the end of March to the middle of April. Young plants in the territory of MEBG did not enter the generative period. The condition of individuals is satisfactory; height is 30–35 cm.

15) *Spiraea hypericifolia* is a low bush, xerophyte. In culture it is involved with shanks and young plants from steppe sites of West Kazakhstan region and a northern part of Mangystau Region. The beginning of vegetation is noted in 1st decade of March; isolation of leaves was from the middle until the end of March.

On a collection individual did not reach a generative state, therefore budding and blossoming is not recorded. A condition of plants is satisfactory; height is 40–50 cm.

16) *Sorbus aucuparia* is a small tree or a bush, mesophyte. The species is involved in culture with young plants from Urdinsky forestry (West Kazakhstan region). The beginning of vegetation falls on the 1st decade of March; isolation of leaves is from the 2nd decade of March until the beginning of April. Young plants in the MEBG collection did not enter a generative state. The condition of plants in culture is good; height is 50–70 cm.

17) *Malus sieversiana* is a tree, a xeromesophyte. In the culture of an individual of an apple-tree are involved with young live plants from a flood plain of the Urals River (West Kazakhstan region). The apple-tree begins vegetation in the 1st decade of March; isolation of leaves is recorded from the 2nd decade of March to the middle of April. Young individuals have not reached the generative period yet. The condition of plants on a collection is satisfactory; height is till 1 m.

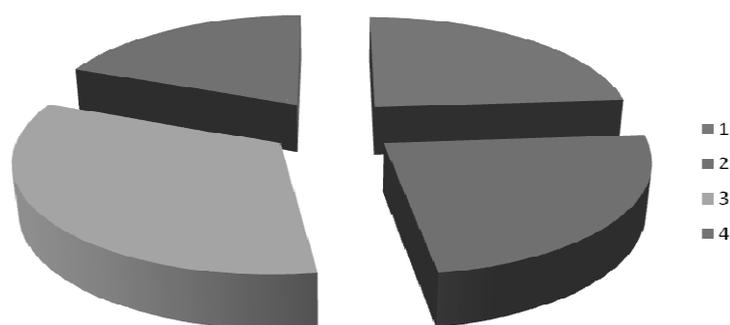
18) *Malus baccata* is a tree, mesophyte. In culture the species is involved with young plants from Mortuk forestry (Aktyubinsk region). The beginning of vegetation falls on the 1st decade of March, expansion of leaves is from the 2nd decade of March until the beginning of April. Generative phases for this species are noted. A condition of a species is satisfactory; height of individuals is 100–120 cm.

19) *Populus diversifolia* is small trees, xerophyte. Plants are involved with live plants and shanks from the Ustyurt reserve (Mangystau region). The beginning of vegetation at individuals is noted in the 1st decade of March, expansion of leaves is in the middle of March, the end of growth of leaves is in the 3rd decade of July. Budding is recorded in the beginnings of April, blossoming from the middle until the end of April. Formation of fruits is noted. Height of plants reaches 1.2–1.8 m. A state in culture is very good.

20) *Prunus spinosa* is a small tree or a bush, mesoxerophyte. Plants are involved alive plants and landing material from natural reservation «The Mountain Big Ichka» and valleys of the Urals River (West Kazakhstan region). The beginning of vegetation is revealed in the 2nd decade of March, isolation and growth of leaves from the middle of March to the 2nd half of April. Plants didn't enter the generative period. A condition of individuals is very good; height is up to 80 cm.

21) *Rubus caesium* is the prickly curling bush, mesophyte. Fruitful forms with large and sweet fruits are selected from Mortuksky forest area (Aktyubinsk region). The beginning of vegetation falls on the 2nd decade of March, isolation of leaves from the middle of March to the middle of April. Budding is recorded at the beginning of May, blossoming is from the 1st decade of May to the middle of August. Fructification is plentiful and stretched, since the end of May until the end of August. Height of shoots in culture reaches 120–140 cm. The state is good.

Introduced species are presented by 4 ecological groups in relation to moistening conditions: mesophytes, xerophytes, mesoxerophytes and xeromesophytes (see Fig.).



1 — mesoxerophytes; 2 — xerophytes; 3 — mesophytes; 4 — xeromesophytes

Figure. Spreading introduced species on ecological groups

The maximum number of species is the share of mesophytes — 7 species, the number of xerophytes and mesoxerophytes was distributed evenly by 5 species, and xeromesophytes — 4 taxa.

The analysis of economic properties showed that from 21 species of woody and shrubby plants 15 taxa have prospect as decorative objects (Table 2).

Perspectives of practical use of new woody and shrubby introduced plants of natural flora of MEBG

Species	Practical use						
	Decorative plants	Food plants	Phyto meliorative plants	Melliferous plants	Herb	Technical plants	Stock for an inoculation of cultivars
<i>Amygdalus nana</i>	+			+			
<i>Astragalus ammodendron</i>			+				
<i>Atraphaxis spinosa</i>			+				
<i>Crataegus sanguinea</i>	+	+		+	+		
<i>Corylus avellana</i>		+					
<i>Padus racemosa</i>	+	+		+	+		
<i>Populus tremula</i>	+		+			+	
<i>Populus alba</i>	+				+	+	
<i>Populus nigra</i>	+		+			+	
<i>Ammodendron eichwaldii</i>	+		+				
<i>Ribes aureum</i>	+	+	+	+			
<i>Rosa laxa</i>	+	+		+	+		
<i>Rosa glabrifolia</i>	+	+			+		
<i>Salix caprea</i>			+			+	
<i>Spiraea hypericifolia</i>	+			+		+	
<i>Sorbus aucuparia</i>	+	+		+	+		
<i>Malus sieversiana</i>	+	+		+			+
<i>Malus baccata</i>	+			+			+
<i>Prunus spinosa</i>	+	+	+	+			
<i>Rubus caesius</i>		+		+			

Ten taxa is possible to use as food plants, 8 species — as phytomeliorative cultures for fixing of sands, slopes of hills and ravines; 11 taxa showed value as melliferous plants; 6 — as medicinal objects, 5 species — as technical plants, 2 species are suitable as a stock for an inoculation of cultivars.

Preliminary results of observations allowed allocating several groups of plants on resistance to local soil and climatic conditions on the basis of a condition of landing material and a habitus:

1) Very steady plants against local conditions, they have good condition of a habitus: *Amygdalus nana*, *Atraphaxis replicate*, *Ammodendron eichwaldii*, *Ribes aureum*, *Rosa laxa*, *Sorbus aucuparia*, *Populus diversifolia*, *Prunus spinosam* *Rubus caesius*.

2) Steady plants against local climate, states in culture are satisfactory. In this group enter such species as: *Astragalus ammodendron*, *Crataegus ambigua*, *Padus racemosa*, *Populus tremula*, *Populus alba*, *Populus nigra*, *Rosa glabrifolia*, *Salix caprea*, *Spiraea hypericifolia*, *Malus sieversiana*, *Malus baccata*.

3) Weak-steady plant, it suffers from a drought. The only species (*Corylus avellana*) is carried to this group.

The correlation between belonging to ecological group and health in culture is not revealed. Among steady and very-steady cultures are noted, both xerophytes and mesophytes. Further testing in culture with expansion of landing material needs to be conducted for woody and shrubby plants entering into the first and second group.

Conclusion

Thus, features of primary introduction of 21 species of woody and shrubby plants of natural flora of the Western Kazakhstan at testing in the culture of MEBG are estimated. Taxa are divided into 3 groups on stability degree: in the first group — 9 species, in the second one — 11 species, in the third one — 1 species.

Distribution of introduced species on ecological groups the following: mesophytes — 7 taxa, xerophytes — 5 taxa, mesoxerophytes — 5 taxa, xeromesophytes — 4 species. The correlation between ecological group of a taxon and resistance to local climate is not revealed.

The analysis of economic and useful properties allowed defining that 15 species are suitable as ornamental plants, 10 — as food, 8 — phytomeliorative, 11 — melliferous, 6 — medical, 2 — as a stock for reproduction of cultivars.

Types for further introductory test are defined.

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Маңғыстау тәжірибелік ботаникалық бағы аумағындағы Батыс Қазақстанның табиғи флорасының ағаш-бұта өсімдіктерін интродукциялау

Мақалада Маңғыстаудың тәжірибелік ботаникалық бағының жағдайында Батыс Қазақстанның табиғи флорасының ағаш-бұталы өсімдіктер 21 түрінің алғашқы интродукциялық сынау нәтижелері келтірілген. Интродуценттер Маңғыстау, Атырау, Ақтөбе және Батыс Қазақстан облыстарының табиғи мекен ету ортасынан таңдалынып алынды. Сыналған таксондар келесі экологиялық топтарға: ксерофиттер (5 түр), мезофиттер (7 түр), мезоксерофиттер (5 түр) және ксеромезофиттер (4 түр) кіреді. Дақылдау бойынша алғашқы сынаулар өсімдіктердің 3 тобын: аса төзімді — 9 таксон, төзімді — 11 таксон, төзімсіз 1 таксон ажыратуға мүмкіндік берді. Шаруашылыққа пайдалы қасиеттерді талдау арқылы 15 түрі сәндік, 10 — тағамдық, 8 — фитомелиоративті, 11 — балды, 6 — дәрілік өсімдіктер және 2 — ұластырылған шыбық ретінде қолданып мәдени сұрыптарды көбейту үшін пайдалануға болатыны анықталды. Таксонның экологиялық тобы мен жергілікті климат арасында корреляция анықталған жоқ. Алдағы интродукциялық сынау үшін түрлер анықталды.

Кілт сөздер: Маңғыстау тәжірибелік ботаникалық бағы, алғашқы интродукция, ағаш-бұталы өсімдіктер, төзімділік, экологиялық топтар, тәжірибелік қолданысы, табиғи флора.

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Интродукция древесно-кустарниковых растений природной флоры Западного Казахстана на территории Мангышлакского экспериментального ботанического сада

В статье приведены результаты первичного интродукционного испытания 21 вида древесно-кустарниковых растений природной флоры Западного Казахстана в условиях Мангышлакского экспериментального ботанического сада. Отбор интродуцентов проводили из природных мест обитания Мангыстауской, Атырауской, Актюбинской и Западно-Казахстанской областей. Испыгуемые таксоны входят в следующие экологические группы: ксерофиты (5 видов), мезофиты (7 видов), мезоксерофиты

(5 видов) и ксеромезофиты (4 вида). Первичное испытание в культуре позволило выделить 3 группы растений: весьма устойчивые — 9 таксонов, устойчивые — 11 таксонов, неустойчивые — 1 таксон. Анализ хозяйственно-полезных свойств позволил определить, что 15 видов пригодны в качестве декоративных растений, 10 — как пищевые, 8 — фитомелиоративные, 11 — медоносные, 6 — лекарственные, 2 — в качестве подвоя для размножения культурных сортов. Не выявлено корреляции между экологической группой таксона и устойчивостью к местному климату. Определены виды для дальнейшего интродукционного испытания.

Ключевые слова: Мангышлакский экспериментальный ботанический сад, первичная интродукция, древесно-кустарниковые растения, устойчивость, экологические группы, практическое использование, природная флора.

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