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Evaluation of successful introduction of plants from *Lamiaceae* family in the conditions of the Karaganda and Zhezkazgan cities

Evaluation of the success of plant introduction is an important stage of determining the possibility of industrial cultivation of individual taxa from an economic point of species. The success of the introduction is assessed on the basis of multi-year observations based on the evaluation of a number of indicators. The purpose of this study is to analyze the success of the introduction of species from the *Lamiaceae* family in the conditions of the cities of Karaganda and Zhezkazgan. The article presents the results of the assessment of the success of the introduction of plants of the *Lamiaceae* family on the territory of the cities of Karaganda (E.A. Buketov Karaganda University) and Zhezkazgan (Zhezkazgan Botanical Garden). In the city of Karaganda, 20 species from 13 genera were analyzed, in the city of Zhezkazgan — 14 species from 9 genera. Promising groups have been identified that allow recommending plants for industrial cultivation. In the conditions of the city of Karaganda, 6 species are classified as highly perspective, 4 species are perspective, 8 species are low perspective, and 2 species are not perspective. In the city of Zhezkazgan, 2 species are highly perspective, 3 species are perspective, 4 species are low perspective, and 5 species are not perspective. Plants suitable for cultivation in the conditions of the city of Karaganda and Zhezkazgan have been identified. The obtained results can be used for production of raw materials for food, aromatic and pharmaceutical industries.

Keywords: success of introduction, *Lamiaceae* family, Karaganda, Zhezkazgan, scoring points, possibility of industrial cultivation.

Introduction

The introduction of plants is one of the initial stages of the cultivation of plants in order to verify the possibility of their growth under certain soil and climatic conditions, as well as for industrial production of raw materials.

Usually, introductory research is carried out in botanical gardens of various levels and botanical organizations [1]. As a result of the introduction into the culture, the question arises of assessing the success of their introduction [2], that is, the isolation of objects suitable for further cultivation and practical using.

Representatives of the *Lamiaceae* Lindl. family today are species of flora with a fairly large content of biologically active substances (aromatic, phenolic, lipid, steroid compounds, resins, organic and mineral substances), widely used in official and folk medicine. Organs and herbs of plants of this family are raw materials for pharmaceutical, food, cosmetic, technical and many other industries [3–11].

In Kazakhstan, this family is represented by 233 species, united in 45 genera [12]. Species of *Lamiaceae* participate in the formation of various types of plant communities, are harvested as essential and medicinal plants, are used as excellent meadow, ornamental and fodder plants [5].

Earlier, in the territory of the Karaganda region, a primary assessment of the distribution of wild species of the *Lamiaceae* was carried out, maps of ranges [13] were compiled; resources of some species were determined [14]. So, out of 50 identified species, 43 species were assigned to essential-oil plants, to medicines — 32 species, to honey — 47 species, to feed — 28 species, to technical — 6 species, food — 7 species, decorative — 18 species and vitamin — 5 species [15].

There is information on the introduction of certain species [16], however, the introductive potential of all representatives has not been practically investigated. Evaluation of the success of plant introduction allows you to choose the species that can be successfully grown in the conditions of the Central Kazakhstan, to be used as a source of raw materials for various industries.

Based on the above, the purpose of this study is to assess the success of the introduction of plants from the *Lamiaceae* family in the conditions of the Central Kazakhstan (the cities of Karaganda and Zhezkazgan).

Materials and methods

The object of the study was the collections of natural flora and medicinal plants of E.A. Karaganda Karaganda University and the Zhezkazgan Botanical Garden. The data analysis covered the period of observations of collectible plants of the *Lamiaceae* family from 1998 to 2018.

The success assessment of the introduction of medicinal plants was carried out according to visual observations on a 100-point scale developed by R.A. Karpisonova and supplemented by A.N. Kupriyanov (2004) [17, 18]. Such indicators as winter resistance, resistance to diseases and pests, the general state of plants, methods of reproduction in culture, the general state of plants during the growing season were evaluated.

Species with 90 to 100 points were classified as highly perspective plants for a given region; from 80 to 90 points — to perspective; from 60 to 80 points — to low perspective; below 60 points — to not perspective (Table 1).

T a b l e 1

Evaluation of introduction success indicators based on visual observations

Parameters	Measure Evaluation Time	Points				
		0	5	10	15	20
Winter resistant	In spring, after growing plants	completely freeze after winter	more than 50 % of individuals freeze	30–50 % of individuals freeze out	less than 30 % of individuals freeze	plants without winter damage
Resistance to diseases and pests	During plant flowering	die due to pests or diseases influence	It is damaged annually and abundantly (more than 50 % of the sheet surface is damaged)	damage severe, but not annual	annual or non-annual non-severe damage (less than 50 % damage)	plants without damage
The general state of plants	Towards the end of the growing season	–	low-power plants that do not reach their natural size in culture	–	do not differ in size from plants in natural habitats	plants are more powerful than in nature
Methods of reproduction in culture	Towards the end of the growing season	–	grow, but do not flower or form seeds	bloom, but do not bear fruit	seed ratio small or not annual	annually bloom and form seeds
The general state of plants during the growing season	Based on the results of many years of observations	–	re-engagement in culture	artificial vegetative reproduction	natural vegetative reproduction	subsequent reproduction

Results and discussion

The points of introduction — Karaganda and Zhezkazgan differ significantly in the complex of soil-climatic conditions [19]. So, Karaganda is located in the steppe zone. The climate is continental with a temperature difference from 20 to 40 ºC. The winter period lasts from mid-late October to April. The average length of the warm season is 180–195 days; the average January temperature is –15.1 ºC (Table 2), July +20.2 ºC. Maximum positive temperatures up to +45–47 ºC, in some years there were decreases in temperatures up to +42 ºC. A stable snow cover forms in the 1st-2nd decades of November and lasts until mid-March. The depth of snow cover is from 30 to 120 cm.

T a b l e 2

Main climatic indicators of Karaganda and Zhezkazgan

Month	Indicator					
	Average air temperature, ºC		Relative air humidity, %		Precipitation, mm	
	Karaganda	Zhezkazgan	Karaganda	Zhezkazgan	Karaganda	Zhezkazgan
January	−15.1	−16.1	60	80	14	23
February	−14.8	−14.6	80	80	14	22
March	−8.7	7.2	82	80	15	23
April	3.0	6.2	68	61	22	17
May	13.1	15.5	55	47	31	13
June	18.6	21.5	53	42	39	20
July	20.2	24.0	55	40	41	18
August	17.3	21.2	58	42	29	13
September	11.8	14.4	70	47	21	10
October	2.8	4.8	80	61	27	15
November	−6.8	−5.1	80	78	17	14
December	−13.3	−12.0	82	80	16	20
Average per year	2.3	4.3	66	62	282	208

Zhezkazgan city is located in the desert zone. The climate is sharply continental, strongly arid, temperature differences reach 50–60 ºC. The winter period lasts from early November to early March. The average January temperature is –16.1 ºC; for July is +24.0 ºC. A stable snow cover is formed in late November — early December and remains until the 1st-2nd decades of March. That is, the growing season is longer, but less precipitation.

Under the conditions of Karaganda, 20 species of plants from the *Lamiaceae* family [20], which belong to 13 genera, underwent an introduction test (Table 3).

T a b l e 3

Indicators of the success of the introduction of plants of the *Lamiaceae* family in the conditions of Karaganda

Genus	Species	Introduction Success Rates, Points
Hyssopus L.	*H.ambiguus* (Trautv.) Iljin	95
	H. officinalis L.	90
Lavandula L.	*L.angustifolia* Mill.	90
Leonurus L.	*L.cardiaca* L.	100
	L. glaucescens Bunge	95
	L.quinquelobatus Gilib.	95
Lophanthus Adans.	*L.schrenkii* Levin	50
Melissa L.	*M.officinalis* L.	80
Mentha L.	*M.arvensis* L.	75
	M.longifolia (L.) Huds.	80
	M.piperita L.	65
Nepeta L.	*N.pannonica* L.	85
Origanum L.	*O.vulgare* L.	75
Phlomoides Moench	*Ph. tuberosa* (L.) Moench	90
Salvia L.	*S. officinalis* L.	50
	S. stepposa Shost.	95
Stachys L.	*S. officinalis* L.	80
Thymus L.	*Th.marschallianus* Willd.	95
	Th.serpyllum L.	80
Ziziphora L.	*Z. clinopodioides* Lam.	90

According to the results of long-term observations, species received from 50 to 100 rating points for the success of introduction. The highest score (100 points) was for *Leonurus cardiaca*, the minimum (50 points) for *Salvia officinalis*. The last object received low scores due to extinction in winter. The remaining species practically did not suffer from winter conditions.

In general, most species received scores from 80 to 95 points, that is, they successfully grow under crop conditions, are resistant to winter conditions, pathogens and can successfully reproduce.

In the city of Zhezkazgan, 14 species from 9 genera underwent an introduction test (Table 4).

T a b l e 4

Indicators of the success of the introduction of plants of the *Lamiaceae* family in the conditions of Zhezkazgan

Genus	Species	Introduction Success Rates, Points
Hyssopus L.	*H. officinalis* L.	90
Leonurus L.	*L. glaucescens* Bunge	100
Melissa L.	*M. officinalis* L.	55
Mentha L.	*M. longifolia* (L.) Huds.	80
	M. piperita L.	60
Phlomoides Moench	*Ph. tuberosa* (L.) Moench	95
Salvia L.	*S. aethiopsis* L.	25
	S. officinalis L.	25
	S. sclarea L.	55
	S. stepposa Shost.	90
Scutellaria L.	*S. baicalensis* Georgi	55
Stachys L.	*S. betoniciflora* Rupr.	90
	S. officinalis L.	65
Thymus L.	*Th. marschallianus* Willd.	65

In desert conditions of Zhezkazgan, 5 species received low success scores, minimum (25 points) were noted for *Salvia aethiopsis* and *S. officinalis*, maximum (100 points) — *Leonurus glaucescens*. The current situation is explained by the fact that on the territory of the city of Zhezkazgan more severe climatic conditions are observed [19], which leads to low indicators of plant introduction.

The results showed that in the conditions of the *city of Karaganda*:
- 6 species are assigned to the group of highly perspective species (*Hyssopus ambiguus, Leonurus glaucescens*, *L.cardiaca*, etc.);
- 4 species are assigned to perspective species (*Hyssopus officinalis, Nepeta pannonica, Phlomoides tuberosa, Ziziphora clinopodioides*);
- low perspective species include 8 species (*Thymus serpyllum, Stachys officinalis, Mentha longifolia, M.arvensis, Origanum vulgare*, etc.);
- not perspective — 2 (*Lophanthus schrenkii* and *Salvia officinalis*).

In the city of Zhezkazgan:
- 2 taxa are assigned to highly perspective species (*Leonurus glaucescens* and *Phlomoides tuberosa*);
- perspective species — 3 (*Hyssopus officinalis, Salvia stepposa, Stachys betoniciflora*);
- low perspective species — 4 (*Mentha longifolia, Mentha piperita, Stachys officinalis, Thymus marschallianus*);
- the remaining species belong to the group of not perspective — 5 taxa.

Species included in the group of highly promising and promising can be used for industrial cultivation in order to obtain raw materials.

Conclusion

Thus, according to the results of research, the results of the successful introduction of plants of the *Lamiaceae* family in the conditions of the Central Kazakhstan were determined; taxa that can be grown on an industrial scale were determined. The obtained results can be used to organize industrial cultivation of plants for the needs of the food, pharmaceutical and aromatic industries.

Acknowledgements

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М.К. Бутумбаева, М.М. Силантьева

Қарағанды және Жезқазған қалалары жағдайындағы *Lamiaceae* тұқымдас өсімдіктер интродукциясының табыстылығын бағалау

Өсімдіктерді интродукциялаудың табыстылығын бағалау шаруашылық тұрғыдан алғанда жекелеген таксондарды өнеркәсіптік өсіру мүмкіндігін айқындаудың маңызды кезеңі болып табылады. Интродукцияның табыстылығы бірқатар көрсеткіштерді бағалау негізінде көпжылдық бақылаулар негізінде бағаланады. Зерттеудің мақсаты — Қарағанды және Жезқазған қалалары жағдайында *Lamiaceae* тұқымдасының түрлерін интродукциялаудың табыстылығына талдау жүргізу. Мақалада Қарағанды (Акад. Е.А. Бөкетов атындағы Қарағанды университеті) және Жезқазған (Жезқазған ботаникалық бағы) қалаларының аумағындағы *Lamiaceae* тұқымдас өсімдіктер интродукциясының табыстылығын бағалау қорытындылары келтірілген. Қарағанды қаласы бойынша 13 туыстың 20 түрі, Жезқазған қаласы бойынша 9 туыстың 14 түрі талданды. Өнеркәсіптік өсіру үшін өсімдіктерді

ұсынуға мүмкіндік беретін перспективалық топтар айқындалды. Қарағанды қаласының жағдайында жоғары перспективалы топтарға 6 түрі, перспективалыға — 4 түрі, аз перспективалыға — 8 түрі, перспективалы емеске — 2 түрі жатқызылған. Жезқазған қаласында жоғары перспективалыға 2 түрі, перспективалыға — 3 түрі, аз перспективалыға — 4 түрі, перспективалы емеске — 5 түрі жатқызылған. Қарағанды және Жезқазған қалалары жағдайында өсіруге жарамды өсімдіктер анықталды. Алынған нәтижелер тамақ, хош иіс және фармацевтика өнеркәсібі үшін шикізат алу үшін пайдаланылуы мүмкін.

Кілт сөздер: интродукцияның табыстылығы, *Lamiaceae*, Қарағанды, Жезқазған тұқымдасы, бағалау балдары, өнеркәсіптік өсіру мүмкіндігі.

М.К. Бутумбаева, М.М. Силантьева

Оценка успешности интродукции растений семейства *Lamiaceae* в условиях городов Караганды и Жезказгана

Оценка успешности интродукции растений является важным этапом определения возможности промышленного выращивания отдельных таксонов с хозяйственной точки зрения. Успешность интродукции оценивалась в ходе многолетних наблюдений на основе оценки ряда показателей. Цель настоящего исследования — провести анализ успешности интродукции видов из семейства *Lamiaceae* в условиях городов Караганды и Жезказгана. В статье приведены итоги оценки успешности интродукции растений семейства *Lamiaceae* на территории городов Караганды (Карагандинский университет им. акад. Е.А. Букетова) и Жезказгана (Жезказганский ботанический сад). По Караганде были проанализированы 20 видов из 13 родов, по Жезказгану — 14 видов из 9 родов. Определены группы перспективности, которые позволяют рекомендовать растения для промышленного выращивания. В условиях города Караганды к группе высокоперспективных отнесены 6 видов, перспективных — 4, малоперспективных — 8, неперспективных — 2 вида. В городе Жезказгане к высокоперспективным отнесены 2 вида, к перспективным — 3, малоперспективным — 4, неперспективным — 5 видов. Выявлены растения, пригодные для выращивания в условиях гг. Караганды и Жезказгана. Полученные результаты могут быть использованы при получении сырья для пищевой, ароматической и фармацевтической промышленности.

Ключевые слова: успешность интродукции, семейство *Lamiaceae*, Караганда, Жезказган, оценочные баллы, возможность промышленного выращивания.

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