



Formation of the electronic database of the collection gene fund of the Mangyshlak experimental botanical garden

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Abstract

The characteristic of a regional complex scale of determination of plants introduction value in Mangystau arid conditions is given. It is considered the special computer program "DInCeR" which except diagnostics of prospects of an introduction allows to enter various registration information on plants into the computer memory, to create lists by families and genus, to prepare the seed catalog "Index Semenium", to select the assortment for the set bioecological, decorative, reproductive, greening and etc properties. Results of forming the collection database for 835 introduced species of native and foreign flora from 58 families and 146 genera are given. Results of forming of the collection database for 835 introduced species of native and foreign flora from 58 families and 146 genera are given.

Keywords: collection, woody plants, introduction value, scale, approbation, computer program, databases

Imanbayeva AA, Belozherov IF (2019) Formation of the electronic database of the collection gene fund of the Mangyshlak experimental botanical garden. Eurasia J Biosci 13: 1405-1412.

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INTRODUCTION

Registration of collection plant species and diagnostics of their prospects for epy introduction are one of priority problems of botanical gardens, especially in extremely rigid climatic conditions of Magystau desert, which has extra arid climate, salinity, low profiled and poverty soils and tension of the wind mode. Available in practice the introduction researches some developments on this direction are generally intended for forest and forest-steppe natural zones (Kosaev 1987, Lapin and Sidneva 1973, Plotnikova 1988, Smirnov 1989, Tyshchenko and Timkina 2011); the most of them include rather narrow list of diagnostic parameters (in general, without decorative properties of introduced species) and also give very high priority to such indicator as "winter hardiness", which in the arid habitat cannot be considered as the basic. In the connection with aforesaid in the Mangyshlak Experimental Botanical Garden (further MEBG) the task of development of a regional scale of determination of prospects of plants was set; the scale would consider the greatest possible quantity of the factors and properties connected with growth, development and application of introduced species.

By drawing up a scale the natural and climatic conditions of Mangystau, long-term experience the introduction researches in MEBG, results of the analysis of average annual bioecological properties of collection species and approbation of the techniques of

determination of viability and prospects of plants, most widespread in other botanical centers, at the same time were taken into account (Kosaev 1987, Lapin and Sidneva 1973, Plotnikova 1988, Smirnov 1989, Tyshchenko and Timkina 2011).

For implementation of the scale in the special computer program 4 programming languages were used: Microsoft Visual FoxPro 9 SP2, Visual Basic For Applications 7.0, HTML 4.0 and JavaScript API 2. Simplification of input of taxonomical units was carried out in the program due to use of the database created according to the list of genera of Brummitt (1992). The phylogenetic system of Takhtadzhyan (1997) was the basis for a systematics.

By the structure the developed Regional Scale includes 24 diagnostic signs (**Table 1**) separated into four sections (groups): 1) biological stability (6); 2) decorative habitus properties (8); 3) reproductive ability (3); and 4) economic, biological and scientific value (7).

The tolerance of introduced species to the conditions of environment determines as the score of their drought-, salt- and winter-tolerances, insistence to fertility of the soil, phyto-phage- and gas resistances. The estimated parameters are specified in a scale as reduction of their

Received: May 2019

Accepted: September 2019

Printed: October 2019

Table 1. The complex scale of diagnostics of introduction value of the plants in the arid conditions of Mangystau

No	Number of sign	Indicator, sign	Assessment interval, in points
I BIOLOGICAL STABILITY			
1.	1.1	Drought resistance	0-15
2.	1.2	Soil resistance	0-10
3.	1.3	Resistance to the winter conditions	0-8
4.	1.4	Insistence to fertility of the soil	0-6
5.	1.5	Phyto-phage resistance	0-6
6.	1.6	Gas resistant	0-5
TOTAL:			0-50
II DECORATIVE HABITUS PROPERTIES			
7.	2.1	Growth form and life duration	0-4
8.	2.2	Originality of a form of growth	0-1
9.	2.3	The general decorative effect of a vegetative part during vegetation	0-3
10.	2.4	Leaf fall ability	0-3
11.	2.5	Intensity (abundance) of blossoming	0-1
12.	2.6	Duration of blossoming, days	0-2
13.	2.7	Esthetics of blossoming	0-4
14.	2.8	Decorative effect of fructification	0-2
TOTAL:			0-20
III REPRODUCTIVE ABILITY			
15.	3.1	Breeding by seed way	0-6
16.	3.2	Breeding by vegetative way	0-4
17.	3.3	Breeds during creation of special conditions or when using other ways of renewal	0-2
TOTAL:			0-10
IV ECONOMIC, BIOLOGICAL AND SCIENTIFIC VALUE			
It is possible to use:			
18.	4.1	- for purposes of green building	0-14
19.	4.2	-for phyto melioration	0-5
20.	4.3	- as food plant	0-9
21.	4.4	- as fodder plant	0-8
22.	4.5	- as herb	0-7
23.	4.6	- as technical plant	0-5
24.	4.7	Phytoprotection status	0-11
TOTAL (не бонее):			0-20
IN TOTAL:			0-100

Table 2. Classes, scores and indexes of value of the introduced plants

Class	Scores	Index of value
I	0-10	Not valuable
II	11-20	Extremely low
III	21-30	Very low
IV	31-40	Low
V	41-50	Decreased low
VI	51-60	Middle
VII	61-70	Increased
VIII	71-80	High
IX	81-90	Very high
X	91-100	Maximal high (etalon)

importance in formation of the general stability. For example, on drought resistance can have until 30% (15) of the total mark amount (50), on gas resistance – only until 10% (5). At assessment decorative habitus properties is considered the growth form, the general decorative effect of a vegetative part, the leaf fall ability, abundance, duration and esthetic value during period of blossoming and fructification. The maximum number of evaluated scores is 20. 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. 10 points are allocated for it. During determining economic, biological and scientific value is taken into account the possibility of their use in the green building, phyto melioration, food, fodder, medicinal and technical purposes; and also the phytoprotection status is considered. As a result score should not exceed 20 (Table 1).

The scale is 100-points, ranged on 10 classes (groups) of value of the introduced plants - from «extremely low» till «maximal high – etalon» (Table 2).

Explanations on some estimated signs of Section 1 “Biological stability” are given below.

Drought resistance. In the conditions of the desert of Mangystau all cultural plants need watering, and the dryness of air is observed annually during the entire period of vegetation, especially in summer months. Therefore at raring of plants according to the degree of drought resistance we used a modified option of a scale of Pyatnitsky (1961) and Kosayev (1987). Plants “with very low” drought resistance require regular watering during vegetation, in the summer at least 2-3 times a week. Generally, hygrophytes and partially meso-hygrophytes enter into this group. Plants with “low” resistance to a drought the irreversible damage to their growth and development is observed at refight with watering more than 15-20 days. The group unites the majority the meso-hygrophytes and mesophytes.

«Average» drought resistance plant can survive without watering of 20-25 days, but, at the same time; it is noted drying up approximately a half of leaves and young shoots. In this group it is included xeromesophytes, partially mesophytes and mesoxerophytes. At introduced species with “high” drought resistance are fixed noticeable negative signs of a drought during the break of irrigation 30-35 days. Part of mesoxerophytes and the majority of xerophytes belong to this group. Plants with “very high” drought resistance also need watering (once in 10-15 days) for maintenance of high decorative effect and gain, but, at the same time, especially in an adult state, they can survive without considerable damages at total absence of irrigation during all vegetative period. The group includes some xerophytes and all ultra-xerophytes.

Soil resistance. Division of introduced species into groups is carried out in a generalized view according to the classifications of Migunova (1978) and Smirnov (1986): a) Halophytes (quite successfully grow at the content of salts of 2.5-3% and more); b) The most salt-resistant (extreme content of salts in the soil at which plants do not lose decorative and meliorative qualities - 2-3%); c) Salt-resistant (1.5-2%); d) The most salt-hardy (1.1-1.5%); e) Salt-hardy (0.7-1.1%); e) Low-salt-hardy (0.4-0.7%); g) Very low-salt-hardy (less than 0.3-0.4%) and h) not salt-hardy.

Resistance to the winter conditions is diagnosed on the scale applied in practice of researches of the dendrology department of Main Botanical Garden of Russian Academy of Science [2] and by methodology of Tatarintsev (1981): a) High-winter-hardy are not damaged by frosts even in unusually severe winters; b) Winter-hardy - slightly freeze slightly (generally one-year shoots - up to 50-100% of length) in severe winters; c) Average winter-hardy are considerably damaged by frosts (biannual and older shoots) in severe winters; d) Low-winter-hardy considerably freeze slightly even in usual winters, and in severe freeze completely; and e) Not winter-hardy - freeze in usual winters.

Insistence to fertility of the soil is understood in narrow sense as insistence to soil saturation by nutrients (oligotrophes, mesotrophes, megatrophes and eutrophes).

Phyto-phage resistance. The scheme of classification of damageability of plants of Kalinichenko (1977) except for index 0 – “a healthy plant” and with the name of groups upside-down, but by the index of the author is applied to diagnostics: 1) high stability - a plant is not damaged in general by wreckers and diseases or damaged not more than 10 by % of anatomic organs; 2) average – the maximum damageability makes 11-25% of a surface of a habitus, strongly struck organs do not meet; 3) low (25-50%); and 4) very low - often plants strongly is damaged that it leads to death more than 50% of their quantity.

Gas resistance. It is used the groups of Dobrovolsky (1967) and Ilkun (1955), plants are ganged on gas-resistant, rather gas-resistant, low gas-resistant and not gas-resistant.

For the Section II of the scale “Decorative habitus properties” it should be noted that in connection with low percent in local flora of Mangystau the plants with durable forms of growth the bigger number of points is appropriated to trees and bushes. In some situations signs 2.5 and 2.7 “Abundance” and “Esthetics of blossoming” are possible to assessment jointly, attracting 4-5 skilled researches in plant introduction.

The last section of a scale IV “*Economic, biological and scientific value*”, - only constructed in a scale by the opened principle, i.e. the sum of evaluation scores can potentially go beyond a limit taken away (20). The reason of it was the fact that the general importance of introduced species is caused at the same time by diversity of practical use and value in each single branch of economic activity of the person and also uniqueness in terms of preservation of a gene pool.

To test the objectivity of plants’ perspective evaluation, the scale was initially tested by the example of 31 representatives of native and 124 representatives of foreign dendroflora with different shapes of growth, decorative, sustainability, and economic value. As a result, the IX class (very high introduction value) includes *Tamarix ramosissima* and *Juniperus virginiana* (82-83 points); the VIII class (high) – *Malacocarpus critlimioliolus*, *Elaeagnus oxycarpa*, *Tamarix elongata* and *Tamarix meyeri*, a hybrid of *Tamarix meyeri* x *Tamarix elongata*, *Haloxylon ammodendron* and *Convolvulus persicus* (71-76 points); the VII class (high) – *Ulmus pumila*, *Tamarix leptostachys*, *Tamarix laxa*, *Tamarix hohenackeri*, and its hybrids with *Tamarix elongata* and *Tamarix ramosissima*, *Halimodendron halodendron*, *Nitraria schoberi*, *Calligonum borszczowii* and *Calligonum caput-medusae* (62-70 points), and the class VI (middle) – *Tamarix bungei* and *Rhamnus sintenisii* (51-59 points), and class IV (low) – *Tamarix litwinowii* (39 points).

The complex scale, even within a relatively small sample of plants of local and foreign flora (155 taxa), mainly with high and very high biological stability, gives a significant spread of evaluation points, which confirms its complexity, objectivity and a fairly high reliability, coinciding with the general preliminary opinion of the introducers about the value of certain taxa. The distribution of taxa by classes is almost symmetrical compared to the previously tested scales ((Kosaev 1987, Kouhbanani et al. 2019, Lapin and Sidneva 1973, Plotnikova 1988, Smirnov 1989, Tyshchenko and Timkina 2011) with the average index, which accounts for 23.9% of plants. Extremely low perspective was diagnosed for 2.6% of the recorded species and forms; very low – for 4.5%; low – for 9.7%; decreased – for

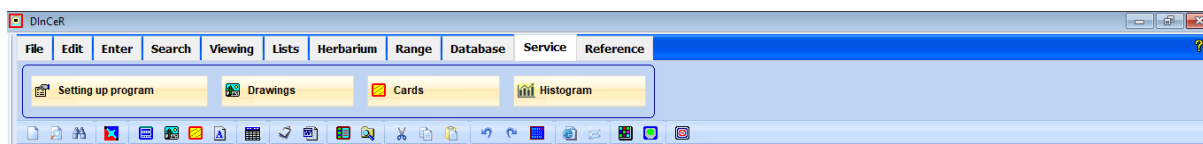


Fig. 1. Main menu of the program «DInCeR»

Malacocarpus crithmifolius (Retz.) C.A. Mey

Text

Taxonomy Names Arrangement Morphology Stability Decorative effect Reproducibility Application In addition Card Drawings

Botanical establishment: SC MES RK "Mangyshlak Experimental Botanical Garden" RSE

Department, site...: DEPARTMENT OF LOCAL FLORA

Arrangement in the Garden:

Registration number: - year: 1974 - No: 341 1974/341

Year of attraction: 1974 Year of inclusion in the collection: 1977

Origin, country: Kazakhstan, Mangyshlak

The organization - the donor: local flora

Initial reproductive material:

Number of copies in a collection: 55 Area of a collection: 19.4

Attack reason:

In Delectus seminum: it isn't i Gerbarny samples: is a

Introduktor: DOSSHCHIYEVA G.ZH.

Performer: - position: the CEO - degree: Candidate - full name: Imanbayeva A.A.

Internet WinWord

Fig. 2. The page «Arrangement» of the form of input and viewing of information

16.8%; increased – for 22.6%; high – for 14.2%, and very high – for 5.8%.

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Work on the transition of the regional scale into the electronic language of the special computer program «DInCeR», which in addition to the module of plants' introduction value diagnostics also contained procedures, forms, and databases designed to enter and store a variety of registration information on systematics, location in the collection, distribution areas, morphology, ecology, herbarium samples, with illustrations, photos, and drawings of plants, was completed in MEBG in 2015.

The main menu of the program contains 11 points: «File», «Edit», «Enter», «Search», «Viewing», «Lists»,

«Herbarium», «Range», «Database», «Service» and «Reference» (Fig. 1).

In the collection database, all 254 fields are divided into input and view forms into 12 groups (pages): «Taxonomy» (Fig. 2), «Names», «Arrangement», «Morphology», «Stability» (Fig. 3), «Decorative effect», «Reproducibility», «Application», «In addition», «Card», «Drawings» and «Text Messages».

The complex regional scale of plants' introduction value diagnostics is implemented in the Program on 4 pages of the form of input and viewing of information: «Stability», «Decorative effect», «Reproducibility» and «Application».

When the user selects one or another evaluation option feature, the program automatically calculates the points and the taxon ranking by classes and indices of perspective (Fig. 3).

There are several ways for quick search of plants that are available when one selects the «Search» point in the Main menu: «Identifier», «Latin», «Russian name», «National name», «Family and name», «Any word».

The information about the plant can be printed, saved on a server, sent by e-mail or to external editors and programs in various graphics and text formats (txt, doc, docx, xls, xlsx, rtf, pdf, tif, xml, etc.). The export possibility of «DInCeR» on the example of redactor WinWord is illustrated in Fig. 4.

The range of plants can be selected in DInCeR in two variants: according to diagnostic features and to the introduction value. The first one allows assigning of up

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Internet WinWord

Fig. 3. The pages «Application» of the form of input and viewing of information

Rosa 'American Heritage'

Department: MAGNOLIOPHYTA
Class: MAGNOLIOPSIDA
Subclass: F. ROSIDAE
Superorder: ROSANAE
Order: ROSALES

ROSACEAE Juss. – РОЗОЦБЕТНЫЕ
Rosa L. - Роза

Rosa 'American Heritage'

Enterprise: RSE "Mangyshlak experimental botanical garden" Of SC of MES of RK
Department, plot: ROSARIUM.
Location in garden: the old plot near central entrance.
Register number: 2001/425. Date of Application: 14.09.2015 y.
Year of inclusion in primary introduction researches: 2001.
Year of including in list of collection: 2002.
Place of origin, country: The main botanical garden, Almaty city.
Organization-donor: Institute of Botany and Phytointroduction of MES of RK.

Fig. 4. Example of export of all information about plant in redactor WinWord

to 30 taxonomic, diagnostic, and decorative-habitual indicators, simultaneously interesting to the user. The second variant as the main one involves the use of indicators of introduction value (assessment of biological stability, decorative properties, reproductive ability and economic, biological, and scientific value).

DInCeR also has an opportunity of program output of plants' geographical location on the interactive Yandex

map on the Internet according to the predetermined coordinates in GPS or decimal degrees (Figs. 5 and 6).

It is also possible to automatically build histograms of the introduction value and display them in "Excel" and "WinWord" (Fig. 7).

In the last two years the fullest registration, biocological and graphic data are entered into the electronic database "DInCeR"; also classes and indexes of prospects for 772 collection plants of MEBG are

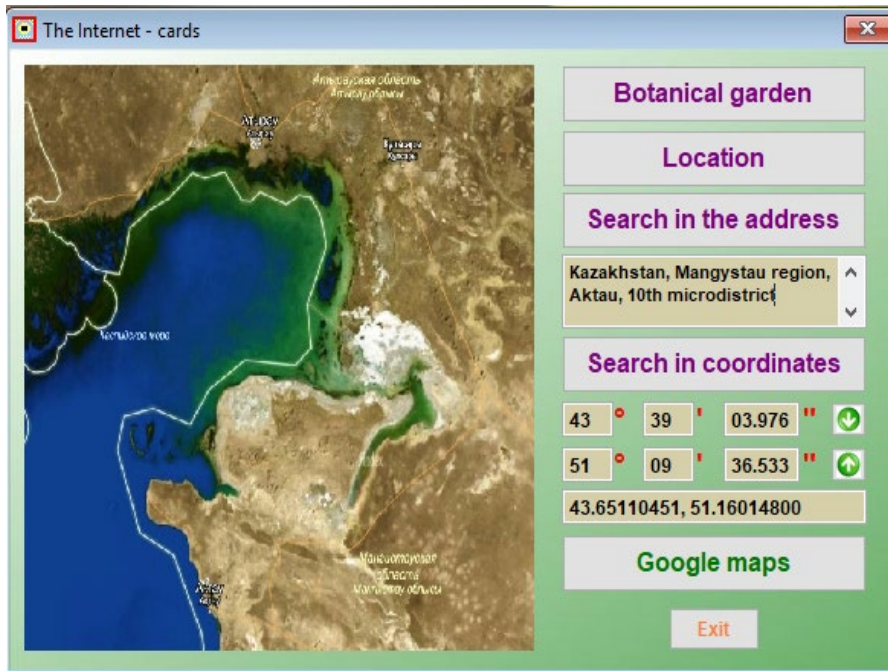


Fig. 5. Internet maps' working form

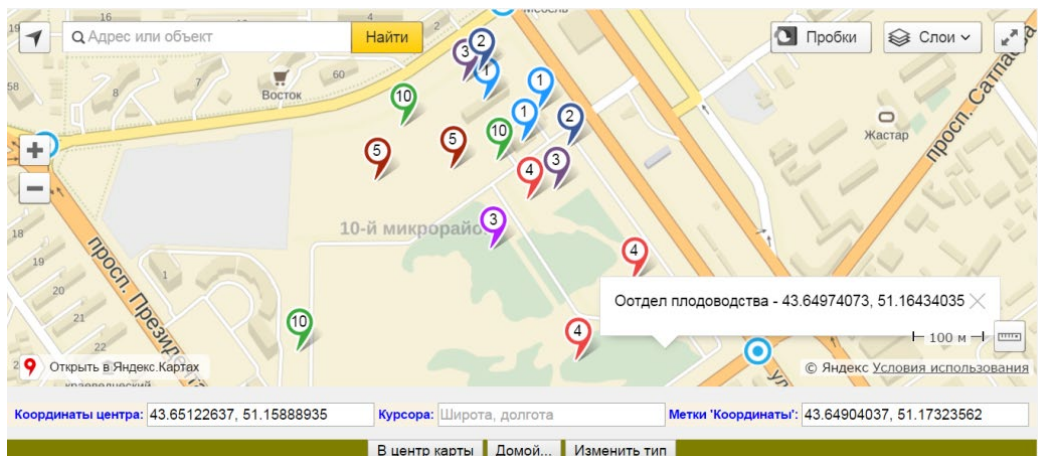


Fig. 6. Yandex-map of MEBG (fragment)

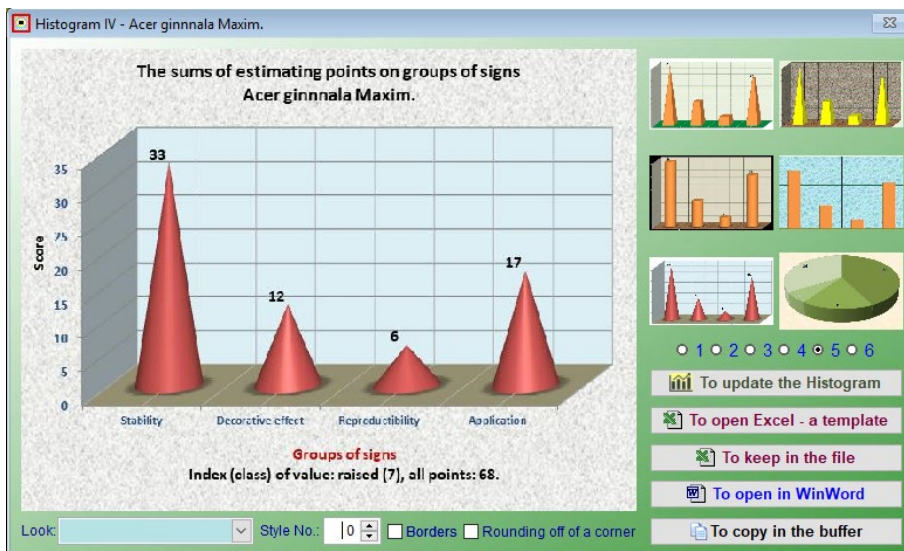


Fig. 7. Histograms' working form

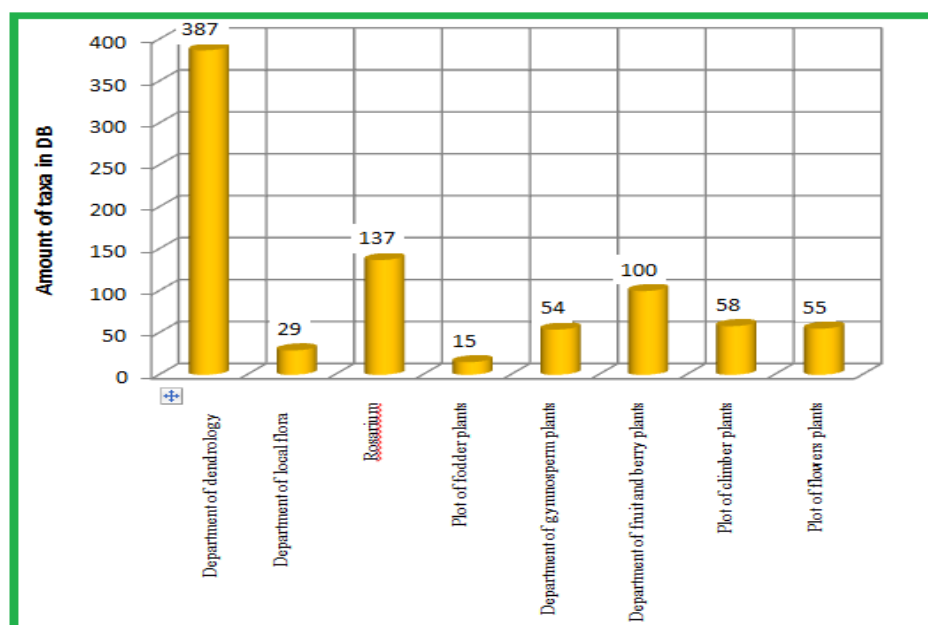


Fig. 8. The composition of DB «DInCeR» on collection department and plots

defined. In total nowadays in DB there are records for 835 introduced species from 6 taxonomical departments, 9 classes, 14 subclasses, 29 super-orders, 56 orders, 9 suborders, 58 families and 146 botanical genera. Approximately a half of taxa (46.3%) entered into the database is the share of non-local-deciduous trees and bushes (**Fig. 8**). On specific weight in a DB representatives of a rosary (16.4%) are on the second place. The share of species of department of gymnosperms plants and plots of the curling and flower plants in the general structure of information DB makes 6.5-6.9%.

According to the results of diagnosing the introduction value carried out with the program, the list of the most promising plants for Mangystau conditions includes 304 names, including 28 coniferous, 49 foreign-deciduous, 26 climbing, and 61 fruit and berry woody plants, as well as 20 representatives of the local

dendroflora and 120 varietal roses. At the same time perspective types, sorts and forms with classes of value of the VI and above generally were included.

DInCeR has the Certificate of State Registration of the Rights to the Copyright Object No. 2339 of December 14, 2015, received in the Ministry of Justice of the Republic of Kazakhstan.

Further development and implementation of a complex scale of plants' introduction value diagnostics and the computer program for PC in the practice of botanical research in arid regions will greatly simplify the creation of information databases, allow searching for taxa quickly and, in general, will expand the possibilities of work with information about the introduced species, as well as reduce the cost for selection of differentiated by soil-meliorative conditions range of plants for the creation of green devices for various functional purposes.

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