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SOME CONTRIBUTIONS ON INTRODUCTION OF THE GENUS *ABIES* MILL. SPECIES IN THE REPUBLIC OF MOLDOVA

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Abstract

The main objectiveof the presentpaper is to studythe biological peculiaritiesof the genus Abies species and formsgrowing and newly introduced in the Republic of Moldova, by their subsequent identification of the most perspectives. As a resultof the investigationsfor the first time arerefined the taxonomicalcomposition that include 23 species, 3 hybrids and 26 forms and cultivars. The questions ofgrowth and development, also the peculiarities offlowering andseed-bearing are studied. Thesustainability of the species and forms ofthe genus Abiesto unfavorable environmental factors i. e. to drought hardiness experimentally are established. The peculiaritiesof seed andvegetative propagationare investigated. For the first timeare tested variousways ofgrafting for decorative formsoffir in thesoil and climatic conditions. Based on the analysis of obtained data are proved the perspectiveof breeding somespecies andgarden formsby vegetative ways. The optimal grafting terms,graftingmodalities and their modificationswith reference to the conditions are recommended. A result of investigationsselected andrecommended for usein green buildingthe mostornamental speciesand cultivars offir.

Key words: *introduction, coniferous, fir, species, cultivars.*

INTRODUCTION

Fir (*Abies* Mill.) is a genus of evergreen forest-forming woody plants in which are provided more than 50 main species is one of the oldest of the eleven existing genera of the pine (*Pinaceae* Lindl.). The species of this genus predominantly in mountainous regions of the northern hemisphere, where they form dark coniferous forest are widespread. The most of them in the area of sub-zones of middle and southern taiga of Siberia and North America, as well as in the mountainous forests of the temperate and subtropical zones of Central and Southern Europe, North Africa and foreign Asia are located (Крылов Г. В. и др., 1986). The species of genus *Abies* have a number of valuable ornamental qualities necessary in green building - this is the durability and monumentality, the high sanitary and recreational properties and the emotional impact on people. These properties in combination with a diversity of ecological peculiarities of different species of fir it can be successfully used to create park, forest park, and other types green spaces.

The introduction in green plantings composition the introduced species is one of the perspective ways of enrichment the biological diversity, as well as increasing the aesthetic value of cultural landscapes. The representatives of the genus *Abies* does not grow in natural conditions of the Republic of Moldova. The first steps on introduction of firs relate to the second half of XIX century – beginning of XX in the gardens and parks of the landlords (Андреев В. Н. 1957; Леонтьев П. В., 1967). Furthermore, the experience on introduction of *Abies* species was accumulated in the botanical gardens and arboretums and, particularly active fir has been implemented from the middle of XX century. However, up to present not yet summarized the rich experience in creating and growing of fir plantings in the Republic of Moldova.

MATERIALS AND METHODS

As biological material for the investigations were served the species and cultivars of *Abies* genus, which grows in the Botanical Garden Academy of Sciences of Moldova (the old and new territory), arboretums, parks and squares

of Chisinau, also the old parks. For carrying out the actual researches a number of known methods, recommendations for clarification of the species composition, determination of heat and drought resistance, winter hardiness, reproductive ability, level of adaptation and the perspective of introduction have been used (Гирс Г. И., Древесные … 1975; Ермаков Б. С., 1981; Зубарева О. Н., 1979; Иванова З. Я., 1982; Методика … 1975; Хромова Т. В. 1980; Черепанов С. К., 1975).

RESULTS AND DISCUSSIONS

As a result of determining and clarifying the taxonomic composition of the genus *Abies* in the Republic of Moldova we have established the 23 species, 3 hybrids, 26 forms and cultivars (Table 1).

Table 1. Taxonomic composition of genus Abies Mill. species in the Republic of Moldova.

Species and hybrids	Cultivars
Abies alba Mill.	Aurea, Columnaris, 'Pendula', 'Pyramidalis'
A. amabilis (Dougl. ex Loud.) Forb.	-
A. arizonica Merr.	-
A. x *arnoldiana* Nitz.	Ioan Pavel II
A. balsamea (L.) Mill.	'Nana', 'Piccolo', 'Hudsonia' Pyramidalis
A. borisii-regis Mattf.	-
A. cephalonica Loud.	-
A. cilicica Carr	-
A. concolor (Gord.) Ldl. ex Hildebr.	'Argentea', 'Compacta', 'Violacea', 'Lowiana'
A. fraseri (Pursh) Poir.	-
A. holophylla Maxim.	-
A. homolepis Sieb.et Zucc.	-
A. x *insignis* Carr. ex. Bailly in Rev.	-
A. koreana Wils.	Brilliant 'Brevifolia', 'Piccolo', 'Lumenetta', 'Silberlocke'
A. lasiocarpa (Hook.) Nutt.	'Compacta'
A. nephrolepis Trautv.) Maxim.	-
A. nordmanniana (Stev.) Spach	'Golden Spreader', 'Pendula'
A. numidica De Lann. ex Carr.	-
A. pinsapo Boiss.	'Glauca'
A. procera Rehd.	'Glauca', 'Kelleris', 'Obrighoven'
A. recurvata Mast.	-
A. sachalinensis (Schmidt) Mast.	-
A. sibirica Ledeb.	-
A. spectabilis (D.Don) Spach	-
A. veitchii Lindl.	-
A. x *vilmorinii* Mast.	-

CONCLUSIONS

As a result of determining and refinement of the taxonomic composition of the genus *Abies* in perennial plantations of the Republic of Moldova revealed 51 taxa. Our studies concerning the growth and development of the genus *Abies* have shown that the soil and climatic conditions of the Republic of Moldova are favorable for growth of many ornamental fir species and cultivars. The entry of 16 fir species in the generative phase indicates to their adaptability to new environmental conditions. The good germinating capacity of seeds of some fir species creates the possibility of their mass reproduction and its following use in the ornamental gardening. On the example of fir blue species was proved that the last have a high heat resistance with respect to the types. Thus, when creating a green plantations under conditions of increased heat should be given preference to the species with a blue coloration of the needles. Based on the researches was proved the perspectivity of reproduction of fir species and cultivars by vegetative way: low growing form by cuttings and with high stems by grafting. For landscape gardening we can recommend 13 fir species and, their ornamental cultivars.

The highest number of forms is distinguished: *A. concolor*, *A. koreana* and *A. procera*. Taking into account the global floristic reserves of the genus (56 species, 2 subspecies, 9 hybrids, 2 varieties and 625 cultivars) [Васильев Н. Г., Уханов В. В., 1949; Крылов Г. В. и др., 1986; Den Oden P., Boom B. K. 1978; Aris G. Anders and Derek P., 2012;], the assortment of used in the green building of the Republic of Moldova is comparatively poor. This basically

it is *A.alba* and *A.concolor*. The other species are used for creating decorative groupings in botanical gardens, arboretums, old parks, as well as in private gardens. Seasonal the growth of shoots is one of the main periods of woody plants life, closely related with climatic conditions of growing.

The study of growth and development of introduced plants in different soil and climatic conditions allows to judge about their adaptation to the new environment and to identify the existence of perspective for the economy. Our observations showed that in Central of Moldova (Chisinau) at the investigated species of fir the growth axial shoots begins in late April – early May, with an average daily temperature of 8-16^{o} C. The end of growth in most species occurs at the end of June – beginning of July. Deadlines of beginning and end of growth vary from year to year, so that the duration of growth is different. The most intensive growth of shoots is observed in May. Blossoming and seed wearing is an important moment in the life of any plant. The entry into generative phase is one of the criteria for assessing the success of plant introduction. Under the conditions of Republic Moldova 'blossom' and form seeds of 16 species of fir. Their strobilation occurs in the first half of May, with an average daily air temperature 9-18° C and the sum of positive temperatures 290-480° C. Strobilation period varies from year to year, is dependent on the weather and lasts from 6 to 12 days. Seed ripening begins in the first decade of October. Whole period of cones from flowering to maturity, depending on the species, lasts 100 to 130 days. For the full development necessitates the sum of positive temperatures – 2150-2800° C. The determination of the quality seeds has shown high laboratory germination (over 70%) in *A. concolor*, *A. nordmanniana* and *A. numidica*, average (40-50%) at *A. alba*, *A. sibirica*, *A. pinsapo* and low (10-25%) in other species. In our opinion low seeds germination is due to the insufficient number of trees of that species. As a result of experimental study (the testing into the water chamber of ultrathermostat UT-15) was established more expressed heat resistance of fir species needles with blue color as compared to green. It is known that an important role in the introduction plays winter hardiness, of plants, moreover in the process of acclimatization, it can change. Currently, 90% of cultivated species of the genus *Abies* have the highest scale of hardiness - I. The part of species has a transitional point, depending on the climatic conditions of the year - I-II. During the period of investigations types and forms of fir showed the complete drought resistance, i. e. in all cases was observed the drought resistance - V by M. R. Duval-Stroev five-point scale [1966]. We have also investigated the peculiarities of seed reproduction. In our experiment, seeds of the local reproduction were used. In the research program was to identify the optimal growing seedlings of some fir species, for what were tested different variants and substrates and pre-sowing preparation of seeds, as well as different sowing dates. The higher germination of seeds group up to 56% of *A. concolor* and *A. nordmanniana* on the substratum consisting of sod soil and river sand (3: 1) was attested. The use of chemical solutions (potassium permanganate - 1%, heteroauxin - 0.01%, superphosphate - 0.5%) for pre-sowing preparation of seeds led to a significant increase in soil germination. Along with the seed method of reproduction, which for the most species of *Abies* was the major, we carried out the experimental study on the impact of different growth factors on the rooting of cuttings dwarf cultivars. We have précised and expanded the reproduction methods of fir cuttings. The higher percentage of rooting from 40 till 55% of the cuttings had the following cultivars: *A. balsamea* Nana', *A. concolor* Compacta', *A. koreana* Piccolo', *A. lasiocarpa* Compacta'. For the first time in the soil and climatic conditions of Republic Moldova was carried out researches on inoculations different species and cultivars of the genus *Abies*. The periods, optimal methods and the impact of chemicals on the intergrowth of inoculations were studied. In our country great attention was paid to the involvement of different fir species and cultivars by transplantation methods. On the basis of the obtained data, we formulated the following conclusion that a highly ornamental fir species and cultivars should be propagated by grafting. The optimal for the reproduction is ***in the fissure of axial sprout through the apical buds***

by cambium on the very center – method modified by us. The best results are obtained by grafting during the spring period, at the beginning of the swelling buds and in summer-fall after the end of shoot growth. The processing of the grafts cut site by solution of succinic acid (0.01%) and dimethyl sulfoxide (0.1%), directly before inoculation leads to increasing the percentage of survival. On the basis of many years of study the growth, development, sustainability and decorativeness for green building of our country we recommend the following species of the genus *Abies* such as: *A. alba*, *A. balsamea*, *A. cephalonica*, *A. concolor*, *A. holophylla*, *A.homolepis*, *A. koreana*, *A. nephrolepis*, *A. nordmanniana*, *A. numidica*, *A. pinsapo*, *A. procera*, *A. sibirica*, and also their highly ornamental cultivars.

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