The use of gymnosperms in urban landscaping of the dry steppe zone

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Abstract. The role of gymnosperms in green urban environments is analyzed. The protective qualities of coniferous species are highlighted. The assortment of evergreens at landscape objects of general and special purpose is presented. Species for the creation of dendrological groups with phytoncidal properties are recommended.

1. Introduction
The value of conifers used in cities landscaping is determined by their all-weather decorative qualities, as well as important protective properties. Coniferous plants are relatively unpretentious, they are frost-resistant, among them there are light-loving and shade-tolerant, tall and dwarf plants. Currently, there are many varieties of conifers with high decorative qualities that enrich the assortment of any coniferous garden. Many conifers are gas-resistant and are part of the main range of green spaces of industrial cities.

Favorable effect of coniferous plantings on the physical and psychological health of the population is also of great importance.

Pine family (Pinaceae) and cypress family (Cupressaceae) are the most common families of the conifers (Pinidae) subclass used in cities landscaping in Russia. These families are the largest in the number of genera and in the number of species [1; 2]. Pine trees are evergreen shrubs and trees. Among them there are dwarf forms. Cypress trees are represented more often than medium-sized trees and undersized [3]. Among the cypress trees there are shrubby forms and creeping, pressed to the ground, for example, the Far Eastern microbiota (Microbiota decussata).

Conifers rightfully occupy an important place in the assortment of urban green spaces. A variety of shades of evergreen needles makes it possible to achieve an impressive decorative effect and the illusion of a large amount of greenery even in the smallest gardens. Evergreens delight citizens all year round with green foliage and a rich aroma of needles.

2. Coniferous plantings as a green filter
In cities, there is a special world of urbanized nature, part of which coniferous plantings are. They perform sanitary-hygienic, structural and planning and decorative functions. They have a unique filtering ability, absorbing and neutralizing significant amounts of toxic components of technogenic emissions from the air, contribute to maintaining gas balance in the atmosphere [4].

For example, European spruce (Picea abies) accumulates sulfur compounds up to 0.414% in the needles and up to 0.171% in the bark to absolutely dry weight with a maximum single concentration of sulfur dioxide in the air of 0,13 mg/m³. In addition, spruce needles adsorb heavy metal salts. Metals
from the group of oxidizing agents (copper, nickel, lead, cobalt, iron) are most actively accumulated by needles [5].

In large industrial cities, plants contribute to air purification, which is more effective the higher their gas resistance is. Typically, these are plant species that form a large biomass and have intense gas exchange [6]. The most gas-resistant coniferous plants are thuja occidentalis (Thuja orientalis), blue spruce (Picea pungens), Corsican pine (Pinus nigra), and Scotch pine (Pinus sylvestris) [7].

Coniferous species are excellent dust collectors. One hectare of coniferous trees holds up to 40 t of dust per year. Thus, the dustiness of the air in the city park, where pine, spruce, fir, juniper and others grow, is reduced by 42% in summer compared to the unlandscaped area, and by 37% in winter.

Almost all conifers show antimicrobial properties, the differences will only be in the degree of its severity. The most universal in their action are phytoncids of coniferous trees - pine, cypress, juniper, fir, etc.

Table 1 presents the decrease in the number of colonies of bacteria and viruses in the territory where the coniferous plants grow [3].

**Table 1.** The degree of reduction of microorganisms in the air (according to Kolesnikov, 1974) [3].

| Name of coniferous plants                  | Reduction in the number of microbial colonies in the air, % |
|-------------------------------------------|-------------------------------------------------------------|
| Arizona cypress (Cupressus arizonica)      | 40                                                          |
| Horizontal cypress (Cupressus horizontalis)| 56                                                          |
| Greek fir (Abies cephalonica)              | 43                                                          |
| Spanish fir (Abies pinsapo)                | 40                                                          |
| Algerian fir (Abies numidica)              | 40                                                          |
| Ponderosa pine (Pinus ponderosa)           | 45                                                          |
| Common yew (Taxus baccata)                 | 41                                                          |
| Redwood bur (Sequoia sempervirens)         | 41                                                          |

The table shows that conifers reduce the number of bacterial and viral microflora in the air by almost half.

Organic inclusion of coniferous plantings in the cities landscaping system contributes to the establishment of a favorable microclimate. In summer, the relative air humidity on city boulevards and squares is 2-8% higher than in the open area, and in urban forest parks by 10-13%. In the shade of a dense, healthy pine plantation on hot days, the air temperature is 7-80°C, and in spruce 100°C lower than in open areas [3]. Thus, the protective qualities of conifers are very high.

### 3. Objects and research results

The composition of urban green spaces is diverse. The main share of green spaces in the dry steppe zone is made up of deciduous trees and shrubs. In order to analyze the assortment of conifers for urban areas landscaping in the dry steppe zone, landscape construction objects in the city of Volgograd were examined, namely Embankment named after 64 Army, Sovetskaya street, Lenin prospekt, park named after Gagarin, Memorial complex on Mamaev Kurgan, Botanical Garden of VSSPU, Arboretum of the Krasnoarmeysky district.

Among gymnosperms at the objects of landscape construction of Volgograd, representatives of the following families grow: Ginkgoids (Ginkgoaceae), Taxodium family (Taxodiaceae), Pinaceous (Pinaceae), Cypress family (Cupressaceae) and Yew family (Taxaceae). A special place is occupied by representatives of Cypress family as the most drought tolerant species.

Representatives of Cypress family (Cupressaceae) grow and spread on urban objects of landscape architecture of general use (streets, boulevards). Species of Juniper family (Juniperus) are frequent, for
instance savin juniper (J. sabina), red juniper (J. virginiana); medium juniper (J. media), flaky juniper (J. squamata), common juniper (J. communis) are less common. On the streets and boulevards, representatives of Thuja family are frequent (Thuja), for example thuja occidentalis (T. occidentalis), eastern thuja (T. orientalis), giant thuja (T. plicata). These species are presented in raw plantings, groups and single copies.

Among pine trees, common pine (Pinus sylvestris), Corsican pine (Pinus nigra), Crimean pine (Pinus pallasiana), mountain pine (Pinus mugo), blue spruce (Picea pungens), European spruce (Picea abies), white spruce (Canadian) (Picea glauca), Siberian larch (Larix sibirica), Douglas fir (Pseudotsuga menziesii) are prevalent.

Species of pine trees family are represented in urban landscaping mainly by single plantings. The most common are blue spruce (Picea pungens) - 25%, common pine (Pinus sylvestris) - 15%, Crimean pine (Pinus pallasiana) - 7%, western thuja (Thuja occidentalis) - 15%, eastern thuja (Thuja orientalis) - 13%, Cossack juniper (Juniperus sabina) - 13%, Virginian juniper (Juniperus virginiana) - 8%, savin juniper (Juniperus squamata) - 1%, common juniper (Juniperus communis) - 3%.

Rare species grow on objects of landscape construction of special significance, namely, in the arboretum and botanical garden. In the arboretum of the Krasnoarmeysky district, dawn redwood (Metasequoia glyptostroboides) of the taxodium family (Taxodiaceae) grows, as well as Ginkgo biloba (Ginkgo biloba), which is a representative of the Ginkgoids family (Ginkgoaceae).

Representatives of Cypress family (Cupressaceae) are cultivated in the botanical garden of VSSPU: microbiota decussata (Microbiota decussata), sawara cypress (Chamaecyparis pisifera), hiba false arborvitae (Thujiopsis dolabrata), juniper confer (Juniperus conferta) and horizontal juniper (Juniperus horizontalis). Species of pine family (Pinaceae) are also cultivated here such as Hidson bay pine (Pinus banksiana), Khingam fir (Abies nephrolepis), European spruce of the nidiformis variety (Picea abies "Nidiformis"), Japanese larch (Larix kaempferi). A representative of yew family (Taxaceae) grows on the territory of the botanical garden – common yew (Taxus baccata) in the form of a low shrub. The listed species grow in a single copy.

4. Design and recommendations

For the design of tree-shrub groups, an assortment of plants of the pine and cypress families was studied, and an assortment of trees, shrubs and herbaceous plants of other families was also considered. This was done in order to emphasize the shape of individual elements and the shape of plants as a whole, to add contrast and nuances. The assortment was selected taking into account the climatic characteristics of the Volgograd region, plant requirements for soil, watering and other agricultural activities [7].

For a variety of shapes, colors and textures, creating accents and contrasts, it is appropriate to use an assortment of other families and diverse life forms.

Coniferous compositions go well with shrubs (rhododendron, heath, brier, barberries, spiraea, evergreen boxwood tree), as well as herbaceous perennials (hosta, ferns, cereals). The main conifers in wood compositions are both tall trees and their compact and stunted forms.

A tree group composed of coniferous woody plants that show phytoncide properties is presented below. Plants included in the group are similar in ecological properties: they are photophilous, require moderate watering, and are moderately demanding for soil fertility. Decorative properties are due to the contrast in the sizes of various representatives of the same family and the contrast in the color of the needles.

Composition of the group:
1. Blue spruce "Hoopsii" (Picea pungens "Hoopsii");
2. Chinese Juniper "Blaauw" (Juniperus chinensis "Blaauw");
3. Oriental Thuja "Aurea Nana" (Thuja orientalis "Aurea Nana")
4. Chinese Juniper "Pfitzeriana" (Juniperus chinensis "Pfitzeriana");
5. Juniper conferta "Schlager" (Juniperus conferta "Schlager");
6. European spruce "Little Gem" (Picea abies "Little Gem").
5. Conclusion

Introduction to the gardening system of new decorative forms of conifers that are resistant to a long dry period and air pollution will contribute to the creation of an evergreen ecological framework of the urban environment. Coniferous species that have been acclimatized to dry steppe conditions at special facilities (in the botanical garden, arboretum) can be recommended for cities landscaping of Volgograd. Coniferous plants will help diversify the assortment of plants planted in the city, and will enhance the protective properties of urban green spaces.

Thus, the more areas occupied by clean or mixed coniferous stands, the more favorable will be the environment in the urban ecosystem of the dry-steppe zone.

References
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