

# The results of the introduction of *Juglans mandshurica* Maxim. into the oak-woods of the Khopyor region

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**Abstract.** An analysis of the results of the introduction of *Juglans mandshurica* Maxim. into the flood-plain oak-woods of the Khopyor is conducted. The total bioecological assessment and prospects of the introduction into the natural flood-plain oak-woods of the Middle Khopyor region for the enrichment of their species composition with the aim of enhancing the sustainability of these ecosystems and optimization of their ecological functions are given. The compliance of the environmental conditions of the growth of introduced stands in the middle reaches of the Khopyor River, original within the natural distribution area is found. Alongside with the identified typical directions of reduction in the indicators of the stability and productivity of this breed in introduced centres in comparison with the natural areas there detected trends in increasing the resistance of the species in the succeeding generations, as a result of clone variability, a selection of species with a high vital potential and adaptive capacity.

## 1 Introduction

In the modern issues, an important place is given to the optimization of natural oak plantations. Within the framework of solving this problem, there are tasks to increase the productivity of plantations, enrichment of aboriginal flora with economically valuable species of trees and shrubs. One of the directions of forestry of the last century was the introduction of valuable species of wood introducents into forest crops. Zoning and acclimatization of species from other regions expands the diversity of local flora, increases the biological potential. The endurance of woody plants of exotic species is the most objectively revealed in the course of a long introduction tests.

The purpose of these studies was to study the current state of the *Juglans mandshurica* Maxim. plantation, introduced in the mid-twentieth century in the natural forest the Middle Khopyor region.

## 2 Materials and Methods

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A grove of *Juglans mandshurica* Maxim. was planted by a forestry of the Balashov in the Pads precinct forest area near the village of Kotovras in the West of Saratov region in a natural grove of the Middle Khopyor region. This grove was announced by the decision of the Saratov regional Executive Committee № 328 of December 27, 1991 as a natural monument "Manchurian walnut Grove". This is one of the two in the field of seed areas of the far Eastern nature – the Manchurian nut – at the age of 65 years. The nature monument has regional, scientific-genetic and ecological significance. In the autumn of October 9, 2016 we conducted a survey of the state of this plant.

Features of the climate of the area are dryness, high continental and high variability from year to year, especially in terms of rainfall. It should be noted the unpredictability of the conditions of the vegetation period, which can be both wet and cool and dry, and the timing of the onset, duration and strength of the drought are also changed in a number of years [1].

Methods of field research included conducting standard forest mensuration and geobotanical descriptions at the site, the study of the peculiarities of forest regeneration processes and the characteristics of the environmental conditions of the environment under the canopy of the forest. The vertical structure of phytocenosis was analyzed on all levels: stand, undergrowth and ground cover. For trees, in addition to the usual morphometric parameters (height, trunk diameter at breast level), the life state was also evaluated by visual criteria of the scale V. A. Alekseev [2].

Winter hardiness was determined by 8-point scale S. Y. Sokolov. The ability to resist the harmful effects of drought was determined visually by the degree of damage to plants on a 7-point scale of I. F. Gritsenko. To assess the adaptive capacity of the species, the scale of A. A. Kalinichenko was used in modification Of N. B. Baranovskaya. Assessment of viability and prospects of introducents is carried out by the method of p. I. Lapin [3]. Mathematical processing of results was performed on a PC using the software packages EXCEL and STATISTIKA.

### 3 Results

Grove is a single plot planting in 1956 with an area of 0.2 hectare. At the present time 95 trees *Juglans mandshurica* Maxim. have height up to 20 meters and a diameter of 20 to 24 cm.

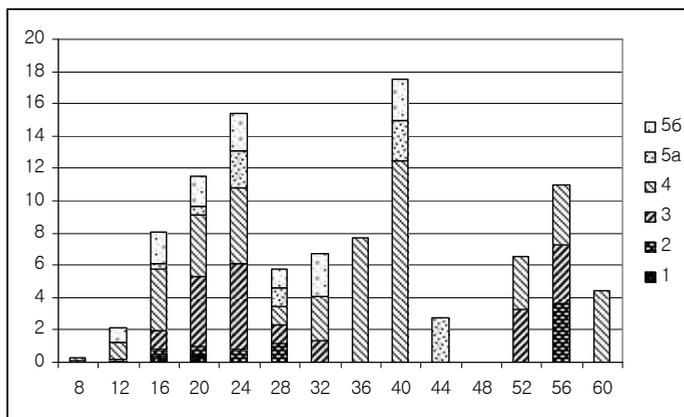
In the plantings trees retain their vital form; almost all have reached the generative maturity. Nut at the age of 60 years has an average height of 18 m, exceeding the indicators in other introduction points in Ukraine, Belarus, Saratov, but not reaching the maximum for the trees of the age limit in nature. The average diameter of the trunk is slightly reduced –  $22.75 \pm 0.21$ , which indicates that local conditions are not optimal. The plants of the genus *Juglans* are grown in many introduction centers, but the indicators of their stability and productivity are reduced everywhere in comparison with natural habitats [3].

Nut is a light-loving breed. Stands have rather low closeness – 0.5-0.6. The elm (*Ulmus glabra* Huds) grows evenly over the entire study area.), pine trees are isolated (*Pinus silvestris* L.). When planting, probably, an analogue of the phytocenosis of natural growth of this species – mixed coniferous-broadleaved forests of the southern part of the Far East was modeled [4]. Also, a significant number of individuals of Holly maple (*Acer platanoides* L.) and ash-tree maple (*A. negundo* L.) were found during the examination. The latter is a weed woody plant and indicates an intensive anthropogenic impact.

The second tier, sparse, up to 6-7 m high from the maple of the Tatar (*Acer tataricum* L.), hawthorn (*Crataegus ambigua* C. A. Mey), buckthorn (*Frangula alnus* Mill.), blackthorn (*Prunus spinosa* L.), spindle tree (*Euonymus verrucosa* Scop.). Two elderberry bushes (*Sambucus racemosa* L.) were met singly. Together with the nut was planted in a

significant amount of hazel (*Corylus avellana* L.), which is not found in the natural forests of the Saratov prihopera. The projective cover of the ground cover is uneven, from 20-30% under a thick woody canopy to 90% in open areas, it is formed from a large number of weeds, forest and weed species that signal violations of the forest habitat of valuable woody plants.

List of stands with their division into classes of life state (Fig. 1) showed his extremely uneven distribution of on stages thickness. The index of the forest stand life state is very low – 17.45. The extremely unfavorable state of life of wood plants, dry-runity was revealed, in some places because of what there is a decrease in the closeness of crowns to 0.3. Probably the poor condition of introduced organisms is the consequences of the several very hot years, and especially the abnormally hot summer of 2010, Drought tolerance is one of the main criteria of successful growth of exotic species in the steppe conditions, in which nut in the planting gets III points during the dry season the leaves wilt, the lower leaves of the shoots take autumn color and fall off. Perhaps its state in the area of introduction is limited by the conditions of water supply and depends on the degree of frequency of dry periods, which is reflected in the graph in the form of dips in some steps of thickness.



**Fig. 1.** The distribution of *Juglans mandshurica* Maxim. in the planting of the steps of thickness (abscissa axis, cm) and stock (ordinate axis, %) with the division into classes of living conditions (1-healthy individuals, 2-weakened, 3 – sick, 4 – dying, 5 – dry (5A – fresh dead – trees that died less than a year ago, 5B – old dead – trees that died in the past).

## 4 Discussion

The success of the introduction largely depends on the compliance of the environmental conditions of the new habitat with the biological characteristics of the species [3]. Manchurian nut grows wild mainly in the valleys of rivers and streams in the Amur region and Primorye, demanding the fertility and humidity of the soil, it grows best on a fairly deep fresh and moderately moist carbonate loams with close occurrence of flowing groundwater. Do not tolerate the wetlands soils [4].

Introduction planting of nut is located in a high part of the Central floodplain of Koper, flooding in this area is often absent or short-term with a large spill. Type of forest conditions D2P - oak forest floodplain fresh. Thus, the area of the floodplain forest in the middle reaches of the river hopper is quite suitable for its environmental parameters for the experiment. Hydrological conditions of growth coincided with the original within the natural area of distribution. The site was valuable for the scientific study of the possibility of introduction of exot in forest crops of the region.

It should be noted that in the conditions of the floodplain of hopra the Manchurian walnut is rather winter-hardy. This is the most frost-resistant species in the genus, on its trunks during the examination did not meet frost – I class of winter hardiness – overwinter without damage. It blooms early and as a result late spring frosts may do damage.

A special indicator of the state of plants-their resistance to pests and diseases – is closely related to their winter hardiness and drought resistance. Found often instances of the class III the state of life – patients (20,3%) or weakened (6,4%), with various Fitopatologiya, with peeling bark and some dry branches, struck by the various types of tinder, stem phytophages. It should be noted the General disadvantage of the plant-accompanying rocks and undergrowth crops are also weakened, warm and humid weather of the growing season in 2011 contributed to the mass development of root rot pathogens here – autumn shedding (*Armillariella mellea* Quel.), as well as black leaf spot (*Rhytisma acerina* (P.) Fr.), which is found even on the leaves of the nut, although it is believed that it is quite resistant to rot and little damage by insects (except old trees) [4].

The predominance of class IV trees – dying (48.9%) and V – dry (22.8%) indicates the instability of planting at this time. The number of trees that died less than a year ago (9.5%) is approximately the same as the old dead wood on the site. A significant percentage of subsenile and senile individuals is due, in addition to natural and climatic factors, to earlier aging of trees in unusual conditions [3].

The loss of certain groups of the composition of stands in different time periods is illustrated in figure 1 in the form of failures in the degrees of thickness.

Against the background the oppressed living condition of walnut intensified coppice shoot formation from dormant buds at the surface of the stand. Almost all trees bear fruit, forming a benign seeds which with the passage of the stratification to germinate well. But it should be especially noted the absence of self-seeding and generative undergrowth in the planting, on the basis of which this species can be attributed to the III level of adaptation of generative development, an invasive inactive group.

In the model the imposition of most instances of grade 1 vitality – healthy – presented low levels of thickness. These are young vegetative plants formed by dying individuals, which often give a large number of shoots. The diagram clearly identifies the generation of the second and third generation with the maximum of 40 and 24 steps of thickness. The distribution into life classes in them reflects the increase in species resistance in subsequent generations as a result of clonal variability, selection of species with increased life potentials and high adaptive capacity. According to the literature data in genetically isolated populations of introducents, when the generations of 3–4-generation reproducers change in the rhythm of seasonal development, they approach native plants, as a result of phenotypic variability, the adaptation of the phenotype of woody plants to these conditions is completed. Already for 8–10 shifts of generations in introduced plants there is a restructuring and genotype, allowing them to adapt to new climatic conditions [3].

The General unfavorable state of forest plantations is associated with both sharp climatic fluctuations and anthropogenic impact. Directly on the territory of the plant is a working sawmills, other farm buildings, agricultural machinery forestry. It is necessary to ensure the protection and restoration of the valuable site by seed planting.

## References

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