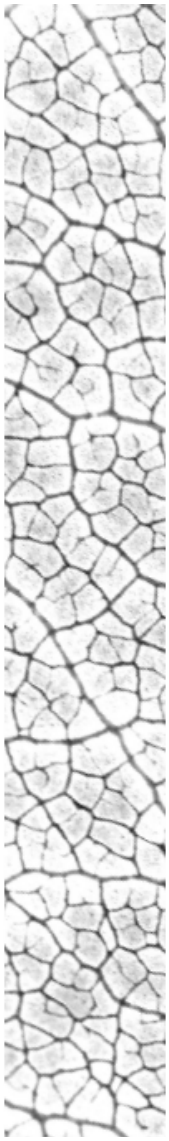

EurAsian Journal of BioSciences
Eurasia J Biosci 13, 983-986 (2019)

Introduction of *Maclura Pomifera* (RAF.) C. K. Schneid, Moraceae Link families under the conditions of the botanical graden of the NRU "Belsu" (Belgorod, Russia)

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Abstract
The data of long-term studies of the biological features of growth and development of *Maclurapomifera* (Raf.) C. K. Schneid in the Botanical Garden of the National Research University "BelSU" is given. The phenological type of development of this species, the beginning and end of its growing season is determined. Winter hardiness, drought resistance, resistance to diseases and pests are assessed to determine the degree of adaptation of the species to local conditions. For the first time, flowering and fruiting of *Maclurapomifera* were noted in the conditions of the Belgorod region. A seed test for germination was carried out. The timing of seed germination was also determined, and the dynamics of seedling formation, growth and seedling formation, up to and including readiness to transplant them to a permanent place, were traced. High germination of seeds without the use of special treatment before sowing, the speed of growth indicates the prospects of reproduction and distribution of *Maclurapomifera* in the Belgorod region. Based on the adaptation coefficient, recommendations are given on the use of *Maclurapomifera* in gardening in the Belgorod Region.

Keywords: *Maclurapomifera*, introduction, rate adaptation, phenophase, winter hardiness, drought tolerance

Martynova NA, Tokhtar VK, Tokhtar LA, Kaliuzhnaya EV (2019) Introduction of *Maclura Pomifera* (RAF.) C. K. Schneid, Moraceae Link families under the conditions of the botanical graden of the NRU "Belsu" (Belgorod, Russia). Eurasia J Biosci 13: 983-986.

INTRODUCTION

One of the main tasks of the Belgorod State National Research University (NRU "BelSU") botanical garden is the introduction of plants from various botanical and geographical zones and their introduction into the landscaping of the Belgorod region (Polukhin et al. 2015, Tokhtar et al. 2016). Of particular interest are exotic plants growing in southern latitudes. Such rare species for the Belgorod region are Osage apple (Maclurapomifera (Raf.) C. K. Schneid) or Adam's apple. Homeland of this species is North America. This dioecious, deciduous tree, reaching 20 m in height at home, is named after the American naturalist Williams Maclura.

According to literary sources (Flora USSR 1936), this plant was first discovered by a Scottish researcher William Danbar during a trip to Mississippi in 1804. His cuttings and seedlings were sent to President Thomas Jefferson. Maclura was brought to Russia in 1833 and was planted in the Nikitsky Botanical Garden (Yalta). Under the conditions of the Crimea, Osage apple is capable of reaching a ten-meter height.

Osage apple wood is dense, yellow, possesses high physical and mechanical properties, it was used in the furniture industry, and the Indians used to make bows and batons. It is believed that the weapons of the Indians made of Osage apple, surpasses such a classic gun tree as the English yew. The leaves go to feed the silkworms, and yellow paint is made from the bark and roots. The branches of the Osage apple are cranked-curved. The shoots are strongly prickly, spines up to 2.5 cm. They are long, located in the leaf axils. Before the invention of barbed wire, Osage apple played an important role in the economy of European settlers, since its plantings were considered the best way to keep livestock within the boundaries of the plot. Osage apple plants have unusual, beautiful and rather large (up to 15 cm in diameter), wrinkled yellow-green fruit-stems, in shape and colour resemble an orange. In the milky sap of Osage apple there are many cyclic triterpenic alcohols in the form of fatty acid esters (Korotkov 2016). This class of biologically active substances that are

Received: February 2019
Accepted: May 2019
Printed: August 2019

widespread in the plant world includes sterols, bile acids, saponins, which are tens and hundreds of times higher than the activity of vitamin P (rutin), vitamins E and C, that is, powerful antioxidants (Korotkov et al. 2014, Vladimirov 1991). In folk medicine, Osage apple tincture is used for wound healing, for diseases of the joints. The content of powerful antioxidants makes it possible to use it for the prevention and cancer treatment.

Thus, possessing all of the above properties, the Osage apple generates great interest for further prospective use in various conditions of the Central Black Earth Region.

MATERIALS AND METHODS

The objects of research were the plants *Maclurapomifera* (Raf.) C. K. Schneid, which grew in the North America environmental-geographical exposition in the Botanical Garden since spring 2003.

Phenological observations were carried out according to the method developed by the staff of the USSR Academy of Sciences State Botanical Garden M.S. Alexandrova, N.E. Bulygin et al. (Alexandrova and Bulygin 1975). Phenophases of the generative and reproductive organs development were noted. For the beginning of the growing season adopted the phenophase “budding”. A sign of the end of the growing season is the phenofase “end of leaf fall”.

The criterion for determining the phenological type of plant development (PTPD) were the methodological approaches outlined by Ogorodnikov (1993).

To determine the coefficient of adaptation for all plants, an annual assessment of winter hardiness, drought tolerance, disease resistance and pests resistance was carried out on a five-point scale, developed by employees of the Rostov Botanical Garden (Kozlovsky et al. 2000). Evaluation of seed reproduction was carried out on a scale of Maleeva (1933).

The degree of species adaptation was determined as the ratio of the sum of the actual points to the sum of the maximum possible points. This ratio is called the rate adaptation and is expressed by the formula: RA = S1 / S * x 100, where: RA is rate adaptation; S1 - the sum of the actual points; S * is the total score of a fully adapted plant.

RESULTS AND DISCUSSION

Osage apple was planted in the Botanical Garden of the Belgorod University in April 2003 by annual seedlings grown from seeds that were brought from Moldova. At the moment, 69 specimens of this species will grow in the collection of the Arboretum Park. Every year, starting in 2003, phenological observations were made of the growth and development of Osage apple, as well as observations of winter hardiness, drought tolerance and damage by pests and diseases.

Phenological observations indicate that *Maclurapomifera* belongs to the representatives of the phenological group of late beginners and late vegetation. Vegetation in this group begins in May and lasts until December. Observations have shown that budding occurs at the end of April or in the first days of May 3.05 ± 5 days, that is, after April 14, the average date adopted for the beginning of the growing season of woody plants in the city of Belgorod.

Studies have allowed us to determine the timing of the beginning and end of shoot growth. Growth shoots began after May 11 (average date) and ended after July 20. The average duration of growth of shoots is 90 days. According to this phenophase, Osage apple also belongs to the phenological group where plants begin to grow late and end late).

In terms of the duration and duration of shoots lignification, Osage apple belongs to the phenological group of plants that begin lignification early and end late. Lignification of shoots begins earlier than the established average date (until June 4) and ends after August 23. On average, the duration of shoot growth is 120 days.

Flowering and fruiting are the most important indicators of the success of the introduction in the growing conditions of this plant. For the first time in 2014, at the age of 12 years, three *Maclurapomifera* trees began to bear fruit and 3 fruits were harvested. The average height of three fruiting Osage apple specimens is 3 m.

Osage apple bloom in 2014 was observed in the period from 2.06. till 9.06. Fruit ripening - at the end of October (26.10 ± 5 days). The fruits of Osage apple belong to the nuts, forming a spherical stem of 12 cm (**Fig. 1**). The average fruit weight is 378.4 g. The average number of seeds in the fruit - 234 pcs. The mass of 1000 absolutely pure seeds is 29.1 grams, which is significantly inferior to the literature data for this species - 40.5 grams. (Krechetova and Krestova 1978).

To determine the germination, the seeds of the harvest in 2016, in an amount of 77 pieces, were sown in a greenhouse on May 18, 2017. Seed germination was 75%. The high germination rate showed that there is no need to take additional measures to soak the seeds in biologics, micronutrient fertilizers, warming up or processing in other ways. The first shoots appeared 27 days after sowing (06/13/2017), full germination of seeds occurred 8 days after the first count (**Fig. 2**). Within 2-3 days, seedlings formed a pair of true leaves. By mid-September, the average height of seedlings was 40 cm. Juvenile plants showed signs of virgin plants, which are expressed in lignification of the basal part of the trunk and the formation of needles in the leaf axils. Seedlings sown in the second half of May are quite suitable for autumn planting in a permanent place.

Fig. 1. *Maclurapomifera* stem

Fig. 2. Seeds germinants *Maclurapomifera*

The first five years of observations of the Osage apple's winter hardiness made it possible to attribute it to medium-resistant plants (3 points), since skeletal branches and part of the annual growth annually froze to 25 cm. With age, the winter hardiness of plants increased and reached 4 points: only damage to the tips of individual shoots was observed.

In relation to the soil moisture, the Osage apple showed itself as a drought-tolerant culture (4-5 points). In the first 2-3 years after planting, watering was carried out during the dry period, and in subsequent years, watering stopped, which did not affect the normal growth and development of plants. From this, we can conclude that the plants studied are mesoxerophytes; the modified leaves and spines are elements of xeromorphism. These ecological and biological properties of plants give them an advantage for use on dry carbonate soils of the Belgorod region.

During the years of observation, there was absolutely no damage to the Osage apple by diseases and pests, due to the absence of specific pathogens and pests.

Thus, the results of our studies allowed us to carry out an integrated assessment of the viability and prospects of the introduction of *Maclurapomifera*. Plants of this species are assigned to a group that is quite promising for use in the conditions of the Belgorod

region (prospect 1): winter hardiness - 4 points, drought tolerance - 5 points, disease and pests resistance - 5 points, seed reproduction - 3 points, rate adaptation - 85 % (Martynova 2009).

CONCLUSION

The activity of the Botanical Garden of the National Research University "BelSU" on the acclimatization of ornamental and rare plants in collections contributes to an increase in the species composition of plants successfully introduced in the Belgorod Region. Such plants that are promising for cultivation in the conditions of the region, according to the results of our study, can confidently be attributed to the *Maclurapomifera*.

For the first time, fruiting of *Maclurapomifera* was noted for the region, which is the most important indicator of the success of the introduction of this plant in the Belgorod region. High germination of seeds without the use of special treatment before sowing, the speed of growth indicates the prospects of reproduction and distribution of Osage apple in the Belgorod region.

Due to its high decorative properties and resistance to biotic and abiotic environmental factors, *Maclurapomifera* is one of the economically valuable plants that can be successfully used in ornamental horticulture. In the future, it can be recommended for use in gardens and parks in the form of group and solitaire plantings, as hedges, protective and ameliorative forest belts.

REFERENCES

Aleksandrova MS, Bulygin NE (1975) Methodology of phenological observations in the botanical gardens of the USSR. Science, 27. (In Russian)

Flora of the USSR (1936) T. 5. L., USSR Academy of Sciences. (In Russian)

Korotkov VA (2016) Development of the composition and technology of a suppository with Osage apple extract. Author. dis. ... Cand. biol. sciences. Kharkiv, 24. (In Russian)

Korotkov VA, Kukhtenko AS, Ordabayeva SK (2014) Analysis of the elemental composition of fruits and Osage apple extracts. Bulletin Kaz NMU, 5(3): 51-53. (In Russian)

Kozlovsky BL, Ogorodnikov AYa, Ogorodnikova TK, Kuropyatnikov MV, Fedorinova OI (2000) Flowering woody plants of the Botanical Garden of Rostov University (ecology, biology, geography). Rostov n./D., 144. (In Russian)

Krechetova NV, Krestova NF (1978) Handbook of forest seed. M., Nauka, 40. (In Russian)

Maleev VP (1933) Theoretical Foundations of Acclimatization. L., Publishing House S.-H. and collective farm. - coop. lit., 168.

Martynova NA (2009) Ecological and biological features of woody plants during introduction in the Belgorod region. Author. dis. ... Cand. biol. sciences. Saratov, 19. (In Russian)

Ogorodnikov AYa (1993) Technique for the visual assessment of the bioecological properties of woody plants in populated areas of the steppe zone. Introduction of plants. Rostov on/D.: 50-58.(In Russian)

Polukhin ON, Petin AN, Martynova NA, Petina MA (2015) Perspective Approaches to the Directional Selection of Plant Species for Revegetation of Ore Mining Dumps of Kursk Magnetic Anomaly. International Business Management, 9(6): 1056-1058.

Tokhtar VK, Martynova NA, Tokhtar LA, Kornilov AG (2016) The Results Of Introduction Of East Asian Origin Flowering Plants In The Southwest Of Central Russian Upland. Research Journal of Pharmaceutical, Biological and Chemical Sciences November, 7(6): 3214-3221. Retrieved from http://dspace.bsu.edu.ru/bitstream/123456789/19583/1/Tokhtar_The_Results.pdf

Vladimirov YuA (1991) Free radicals in living systems. Biophysics. Results of science and technology. M., All-Russian Institute of Scientific and Technical Information Academy of Sciences of the USSR, 252. (In Russian)