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Results of Research on the Aquatic Plant Carolina Azolla (Azolla Caroliniana Willd)

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Abstract. The article presents the biological characteristics and distribution of high water plants Carolina Azolla (Azolla caroliniana willd.). Information on the level of reduction of water mineralization by the growth, development, reproduction of aquatic plants in the collector and ditch waters is given.

Key words: High water plants, pistia (Pistia stratiotes L), azolla (Azolla caroliniana Willd), ryaska (Lemna minor L), reproduction, biomass.

Karolina azollasi - *Azolla caroliniana* Willd. (1-расм). Vatani – Shimoliy Amerika bo‘lib, u tropik va subropik mintaqalarda keng tarqalgan. Azolla suv yuzasida suzuvchi chiroyli yashil orolchalar hosil qiluvchi qirqquloqdir. Azollaning 25 qazilma turlari ma’lum. Hozirgi davrda *Azollaceae* oilasining 6 tagina turi bo‘lib, ular 2 kenja turkumga - *Euazolla* va *Rhizosperma* kiradi. Ular o‘zaro reproduktiv organlarining morfologiyasi bilan farqlanadilar.

Euazolla kenja turkumiga megasporasi 3 ta massul o‘simtasi – gloxodiya bo‘lgan azolla turlari kiradi. Bu kenja turkumga paporotniksimon azolla (A. *fliculoides* L), karolina azollasi (*A. caroliniana Willd.),* meksika azollasi *(A. mexicana* Presl.*)* va mayda bargli azolla (*A. micriphilla* Kaulfuss) kiradi.

Rhizosperma kenja turkumiga suzuvchi apparati 9 massul – gloxodiyasi bo‘lmagan azolla turlari kiradi. Bu kenja turkumga patsimon azolla (A. pinnata Brown) va Nil azollasi (A. nilotica De Caisne) kiradi. A. nilotica De Caisne faqat Markaziy Afrikada uchraydi, qolgan turlar esa turli kontinentlarda keng tarqalgan.

Janubi-Sharqiy Osiyo va Afrikadan tashqari azollaning turlari AQSH, Kanada, Meksika, Angliya, Yangi Zelandiya, Irlandiya, Chexiya, Slovakiya, Germaniya, Yaponiya va MDH mamlakatlarida uchraydi. MDH mamlakatlarida A. filliculoides, A. caroliniana ko‘p tarqalgan. Dnestr, Dnepr va Janubiy Bug daryolarining quyi oqimlarida topilgan (Dubina, Shelyag-Sosonko, 1981).

Karolina azollasi -azolla caroline, suv o‘tlarining biologik xususiyatlari.O‘zbekiston qishloq xo‘jaligi uchun muhim “topilma” bo‘lishimumkin bo‘lgan suv o‘simligi

1- rasm. Laboratoriya sharoitida o‘stirilgan azolla

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Anatomical, morphological, paleontological features of Azolla species, ways of introduction have been studied by many scientists in foreign countries.

This category was first described by Lamarck in 1783 [15]. From a systematic point of view, it belongs to the Azollaceae family, the Salviniales tribe, the Polypodiopsida class, and it is a floating plant with a size of 0.7-1.8 cm [6].

6 types of azolla in the world -Carolina azolla (A. caroliniana Willd.), Four-eared azolla (A. filiculoides Lam.), Mexican azolla (A. mexicana Presl), Small-leaved azolla (A. microphylla Kaulfuss), Patsimon azolla (A. pinnata R.Br.), Nile Azolla (A. nilotica De Caisne) species [7].

Nile Azolla (A. nilotica De Caisne) is found only on the banks of the Nile River. Other species are widespread throughout the globe in tropical temperate climates. These species grow in mats in standing water and slow-flowing bodies of water. They reproduce mainly vegetatively, side branches are easily cut off and spread to other water bodies along the water flow. In some continents, the spread of Azolla species can be caused by birds, aquatic animals and people [6].

Azolla is found mainly in freshwater ponds of tropical countries. His native country is Vietnam. In ancient times, azolla was widespread in Central Asia, and its remains were found in Ustyurt (Oligocene) [8]. A.W. Moore (1969) notes that about 25 species of Azolla have been found fossilized [9].

D.V. Dubina, V.V. According to Protopopova (1980), the species A. caroliniana, A. filiculoides belonging to this family are found in some water bodies of Ukraine, mainly in the lower part of the Dnieper, Dniester and Southern Bug rivers [10].

G.C. Avena and others. According to (1974) [106], Azolla caroliniana was also found in the Tiber River flowing through the territory of Rome and Torritta, and was also found for the first time in Latium (Central Italy). In the Russian states, there are sedge-like azolla (A. filiculoides) and carolina azolla (A. caroliniana) [7].

Azolla species are acclimatized in America, New Zealand, England, Ireland, Germany and Japan. Carolina azolla (Azolla caroliniana) was introduced in the eastern part of the USA, the West Indies, Spain and is also found in France, the Netherlands, Germany and other European countries. Mexican Azolla (A.mexicana Presl.) is distributed from South America to Canada; small-leaved azolla (A. microphylla) occurs in the Hawaiian Islands;

Patsimon azolla (A. pinnata.) is widespread in the southern part of Africa, Australia, Indonesia, Philippines, India, Vietnam, China and Japan. In the conditions of Ukraine, D.A. Dubina and V. V. Protopopova determined the distribution of A. caroliniana and A. filiculoides in the basins of the Danube River and studied their ecological and biological characteristics in depth [10], [11].

T.A. Lumpkin and D.L. According to Plucknett, animals also play an important role in the development and spread of Azolla species in natural conditions. For example, birds have a great influence on the distribution of Azolla species growing in the countries of South-East Asia. Reproduction of Azolla is carried out mainly by vegetative means. Its lateral branches are easily separated from the mother body and spread with the help of water flow [12]. Azolla reproduces sexually.

D.V. Dubina and R. Shelyag-Sosonko studied the annual life cycle of the species A. caroliniana and A. filiculoides in the lower reaches of the Danube River into 6 conditional stages. That is, these steps:

1st winter stage (January, February and beginning of March);

2 - early spring stage (mid-March, April); 3 - spring stage (May); 4 - first summer stage (June);

5th late summer stage (August, September); 6 - early autumn (October); and the pre-autumn-winter stage (includes November and December) [13], [14].

In Uzbekistan, the dynamics of seasonal growth, development and reproduction of A.caroliniana A.T. Dosmetov observed 5 conditional stages in the conditions of Sirdarya, which consist of the following:

1. Winter period (December, January, February);
2. Early spring period (until the middle of March and April);
3. Spring - summer period (starting from the third ten days of April and continuing until the end of May and June);
4. Summer - autumn period. (July, August, September);
5. Late autumn period (October, November) [24].

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Azolla species are used to improve soil fertility, as nutritious supplemental feed in animal husbandry [15], and as protein and nitrogen accumulators in wastewater treatment. Since it contains methane (biogas) gas, it can be used as a fuel factor. It should also be noted that Azolla can serve as a source of hydrogen. Hydrogen is the "fuel of the future" [16].

Until the 1990s of the last century, Azolla species were not found at all in the territory of Uzbekistan. 1991 Russian Academy of Sciences Soil science and photography from the collection of the photobiotechnology laboratory of the Institute of Photobiotechnology, the species of Azolla are Carolina Azolla (A. caroliniana) and Feather Azolla (A. pinnata) (Prof. Gogotov 1991). A. pinnata died without being able to adapt to the conditions of Uzbekistan [3]. Since the introduction of the species A. caroliniana, a number of scientific researches have been carried out by the scientists of the IICHM "Botany" of the Russian Academy of Sciences.

Since the Azolla plant has recently been acclimatized, the correct selection of the conditions and nutrients necessary for its growth and development is the main factor in their study.

Initially, A. Rahimov et al., (1995) in order to select a suitable nutrient medium for the growth of A. caroliniana and A. pinnata, placed them in mineral /Olsen, /"M", organo-mineral "OM" and organic "O" nutrient media. raised.

In comparative experiments in nutrient medium in April:

Average daily yield of A. pinnata - 51.2 g/m2;

A. caroliniana - 42.7 g/m2, in May:

A. pinnata - 102.5 g/m2; A. caroliniana - 67.5 g/m2, in June:

A. pinnata 289.3 g/m2;

A. caroliniana - 96.5 g/m2, in September:

A. pinnata -185.7;

A. caroliniana 58.1 g/m2, in October:

A. pinnata - 78.3 g/m2;

A. caroliniana produced 9.6 g/m2 of biomass.

In further experiments, the daily yield of A. pinnata in June is:

It was -310-328.5 g/m2 in "O" and "OM" environments.

Average monthly yield of Azollas:

-19.4 t/ha in "O" environment;

-16.0 in "OM" environment;

-15.0 t/ha wet mass was formed in "M" environment. Amount of nitrogen accumulated by A. pinnata during one month:

-57.0 t/ha in "O" environment; in "OM" environment - 32.4 t/ha;

In "M" environment it was -28.1 t/ha. Amount of total protein in Azolla biomass (relative to absolute dry mass):

-28.1% in "O" environment; -26.4% in "OM" environment; -24.8% in "M" medium [75].

Therefore, Azolla absorbs nitrogen by forming the necessary amount of biomass in different nutrient environments without losing its properties even in our conditions. The use of these useful properties of Azolla in agriculture, especially in rice cultivation, allows to obtain an ecologically clean and abundant harvest. E.E. Yunusov et al. According to (1991), at the beginning of March, when the average air temperature was 7-100C and the water temperature began to rise, the growth of Azolla individuals was observed as a result of the beginning of the assimilation process, that is, they divided and began to grow. Azolla contains 18.7-36.2% protein, 36-58% carotene and a lot of trace elements [3]. A. caroliniana biomass is grown and used by the staff of the laboratory of algology and hydrobotany in poultry farming, in the preparation of additional protein-vitamin and mineral feed in fisheries, as well as for the purpose of biological treatment of wastewater. When Azolla biomass is used as an additional protein-vitamin and mineral feed, positive results were obtained when replacing 10% of the basic diet of chickens adapted to local conditions belonging to the "Gulistonparranda" cooperative society with Azolla biomass [2]. Rs. Shoyaqubov and others.

In order to develop a biotechnology for the purification of wastewater from hydrolysis production plants from organic-mineral substances and various harmful bacteria, algae (scenedesmus, chlorella) and

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aquatic plants (determined the total number of saprophytic and Escherichia coli bacteria in treated and untreated wastewater during laboratory experiments on purification using pistia (Pistia stratiotes L., Araceae), carolina azolla (Azolla caroliniana), ryska (Lemna minor L.), In the experimental version where Carolina Azolla was grown, the total number of saprophytic bacteria in the wastewater before the experiment was 147104 cells/ml, after the experiment, their total number was up to 45104 cells/ml, and the total number of Escherichia coli bacteria was 37104 before the experiment. if the host was /ml, after the experiment they total number decreased to 25102 cells/ml.

In 2004, at the Regional Fish Farm of the Research Center for the Development of Fisheries of Uzbekistan, which of the plants of ryaska (Lemna minor L.), azolla (Azolla caroliniana), pistia (Pistia stratiotes L., Araceae) is good for fisheries in order to determine its effectiveness, the consumption of high water plants by this year's fry of white carp fish was tested. For this, 285 fish fry were raised in 3 concrete ponds with a volume of 32.4 m3. Average weight, total weight, and length were measured before placing the fish in the ponds for cultivation. The fish in the first pond were fed Azolla, the fish in the second pond were fed ryaska, and the fish in the third pond were fed crushed pistachios. During the experiment, the growth of the fish is the first was 14% in the pool, 23% in the second, and 95% in the third [91].

H.S. According to Rao (1936), Azolla is a small (0.7-1.6 cm) aquatic plant that floats on the surface of water. It has a root in the underwater part, and a small leaf in the upper part and a bud in the leaf axil. It has a separating layer in the jointed part of the stem and the bud, which is the main criterion for vegetative reproduction. Each leaf of Azolla consists of two segments. The segment on the surface of the water is covered with natural photosynthetic pigment forming several layers of small cells. The lower segment consists of flattened and demarcated (1-2) cells, but without chlorophyll and is immersed in water (0.2 mm).

A leaf with multi-layered photosynthetic cells is formed in the water surface of Azolla. The process of fixation of free nitrogen in the atmosphere takes place in this part of the leaf. The root of Azolla in the underwater part is 1-1.5 cm long from the part that touches the water. It creates a separating layer at the junction of the root and the bud. With the formation of root hairs, it sheds the outer covering skin, as a result, it prepares the ground for the emergence of a new plant. Because Azolla is a plant that reproduces mainly vegetatively. For this, the side shoots are easily separated from the main stem and spread around with the flow of water [4].

E.E. According to Yunusov et al., A. caroliniana reproduces in nature mainly by budding. When the conditions are sufficient, small A. carolinianas emerge from the azolla body in 3-4 days, and their preservation during the winter period for the next year is a very difficult task [3].

The mother plant is easily separated from the mother body after the side branches have matured. Separated side branches spread with the help of water flow and begin to grow independently. At the beginning, the mother plant had one main root, then new roots (rhizoids) began to form during the growth of side branches. Another characteristic of Azolla vegetative reproduction is that the mother body (plant) is completely divided and turns into a young body (plant). Then, when the lateral branches form roots, the mother root loses its characteristics and separates from the body. After the separated young (daughter) plant becomes an adult, after 9-10 days it continues to reproduce vegetatively. [2].

Sporaphyte of A. caroliniana branched, floating on a 25 mm long stem. It has two rows of small (0.5-1 mm) leaves on its top, covering the branch as if it were a pepper. Long rhizomes hanging in the water can be seen from some joints of the branches. The conducting tissue of the branches is a siphonostella in the form of a reduced protostella [1].

According to these data, the sporophyte of the plant has branched floating roots of 25 mm and hangs long in the water. The results of the research showed that 5-7 white, 5-9 brown, black filamentous roots were formed in some joints of young A. caroliniana lateral branches separated from the mother plant, and the number of lateral branches shows the formation of new roots with its increase. The formed rhizomes are white 0.5-5 mm, then brown, black (1-4 cm) colored filaments for 1-3 days, with different lengths during vegetative reproduction (the number of roots 9-38) and some roots lose their characteristics and separate from the plant. These rhizomes not only provide the plant with nutrients, but also help it to stay suspended on the surface of the water.

Air temperature 25-300C, water temperature 15-180C, pN 5.5-6.5 in the nutrient medium, light 40-60 thousand lk, 10% of the plants planted after 1 day increased vegetatively. , A. caroliniana produces small

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plants, the length of the body is 4 mm and the width is 1 mm, two rows of leaves are placed on the unbranched body. The number of roots ranged from 1 to 5, and the length was observed to be from 1 mm to 35 mm. When the seedlings are planted, they are very sparsely located on the surface of the nutrient medium, and each leaf develops

In 3 - 11 days, the separation of young plants was observed.

Under the conditions of introduction, A. caroliniana forms 5 to 9 branches in limited (artificial) ponds and ponds. On the upper side of the branches, 0.5 mm leaves are located like two rows of fish scales, the increase in the number of leaves and branches forms the mother plant, and the young plant separates from the mother body and reproduces. A. caroliniana seedlings require some time for their vegetative reproduction after planting in the nutrient medium. This time is the period of development of the vegetative organs of the plant, which lasts 3-11 days depending on the amount of light, air and water temperature, pH, and the composition of the nutrient medium. Development of A. caroliniana, growth rate of leaves their maturation period has a correct correlation with the release of ketene from the plant, air and water temperature.

A number of studies were conducted to study the morphology and reproduction of A. caroliniana under different conditions, the results of some of them are presented in Table 1.

According to the results of observations, when A. caroliniana is grown in open pits, its root length is 3.11±0.15 cm, the length of branches is 1.93±0.12 cm, the number of branches is 5.2±0.41, and the number of roots is 8.9± It was 1.24.

Table 1

*A. carolinianan*i morfologiyasi

Sharoitlar	ildiz uzunligi, sm	shoxchalar uzunligi,sm	shoxchalar soni, dona	ildiz soni,
Chegaralanmagan zovurlarda	3,11±0,15	1,93±0,12	5,2± 0,41	8,9±1,24
Chegaralangan suv havzalarida	4,18±0,21	4,51±0,23	7,6±0,37	29,5±2,97

The number of branches (4.51±0.23) and roots (29.5±2.97) was high in the limited artificial basins.

Figure 1.A. general appearance of caroliniana

Azolla is an aquatic plant, a symbiotic (harmonious) organism consisting of Azolla and its blue-green algae Anabaena. Anabaena azollae belongs to the Nostocaceae family Fig. 1

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