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Ferula varia (Schrenk) Trautv. prospects for the cultivation and use of hydrogels (Kyzylkum desert)

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Abstract. The article provides information on the initial technologies for growing *Ferula varia*, which are distributed in the arid regions of Uzbekistan, and their prospects. Considered a research area, the Kyzylkum desert is considered a dry and low-fat annual area. The result of the meterological analysis of 2020-2023 shows ush that the annual fat content in these years was around 80-110 mm. The species of genus Ferula mostly grows in mountainous regions and some are distributed in arid climates. Various species of *Ferula* Tourn. ex L. have been reported from Central Asia, Pakistan, India and western Himalayas. Some species of the genus are commonly used as spices. Some of species of genus *Ferula* are used in the preparation of local drugs. These plants are also known to be a rich source of gum-resin used in folklore medicine. Ongoing research has been conducted based on the variants (experience, hydrogel effects) of *Ferula varia* of the Kyzylkum desert station. Hydrogel is a synthetic polymer with high water permeability, which allows to store a large amount of moisture in the soil for a long time. Water that enters the soil through atmospheric precipitation or irrigation is stored in the hydrogel in a state where it easily passes to the roots of plants and is released when the plant needs water. Planted specimens were planted during the autumn and spring seasons.

Keywords *Ferula varia*, medicinal plants, desert region, hydrogels, climate change

1. Introduction

Today, drought and lack of water sources have become one of the pressing problems of the world [1]. Worldwide demand for water for agriculture is expected to increase by 60% by 2030. Global food production is also severely affected by drought [2]. The drought sharply negatively affects the yield of medicinal, vegetable and legumes and its quality, leading to an exacerbation of food shortages. In overcoming this situation, it is one of the pressing issues to gain the resistance of medicinal and food crops to negative abiotic factors and to introduce modern agrotechnologies of their cultivation into agriculture.

Based on the experience of developed overseas countries, it is important to analyze the composition of hydrogels used in rural agriculture, synthesize high-moisture-retaining hydrogels based on local raw materials, which allow plants to germinate quickly and obtain high yields in arid areas [3, 4]. In this place, it is considered important to grow plants that are medicinal and have an important economic commitment.

Hydrogels are also known as 'reversible' or 'physical' gels if molecular entanglements and/or secondary forces such as ionic, hydrogen bonding or hydrophobic forces play the principal role in forming the linkage [5]. Physical gels are often rescindable and it is achievable to dissolve them by altering the environmental conditions, such as pH and the ionic strength of solution or temperature. In 'permanent' or 'chemical' gels, the linkage of covalent bonds linking distinct macromolecular chains can be attained by crosslinking polymers in the dry state or in solution [6].

The genus *Ferula* L. belongs to family Apiaceae (Umbelliferae) [7]. Several species of *Ferula* are commonly used as spices and in the preparation of local drugs [3, 8]. These plants are known to be a rich source of gum-resin used in folklore medicine [4, 9]. It is considered to be an anthelmintic, antiseptic, antispasmodic digestive, analgesic, carminative, diuretic, expectorant, laxative, and a sedative in its properties [10].

In Central Asia, including Uzbekistan, in folk medicine, a variety of hiltit (ingi badbuy, sami; bokhchair, shair) is used to treat gastrointestinal diseases as an anticonvulsant and antispasmodic agent; it is also widely used as

a choleretic. According to numerous domestic [11] and Russian [12] scientists, tinctures and decoctions of hiltite, as well as medicines made on its basis, can be used in the treatment of tuberculosis, hysterical and convulsive symptoms, epilepsy and hallucinations, rheumatism and bronchial asthma, chronic diabetes mellitus, various venereal and skin diseases diseases, cirrhosis of the liver of various degrees, malignant tumors of various origins [13].

By medieval folk healers, "gum resin", obtained from the *Ferula* plant, was used by Armenian folk healers in their practice in the treatment of respiratory tract diseases, as well as bronchitis and cerebral atherosclerosis. The Russian author A.A. Utkin [14] noted that Ferula is an effective remedy in the treatment of nervous diseases. The use of *Ferula* juice as an effective anthelmintic has been scientifically proven. Turkmen healers have long used gum resin of the *Ferula* plant as a wound healing agent in their practice. It is appreciated by them in the treatment of various gastrointestinal diseases of humans. Kazakh healers use ferula gum when people are bitten by tarantulas and snakes. It acts as a detoxifying agent. Pharmacists have experimentally developed a 1% diversolide ointment based on the resin of the gum of the *Ferula* plant, which is an effective remedy in the treatment of diseases associated with traumatic corneal erosions. The ointment also has a strong antibacterial effect.

In both folk and traditional medicine, the resins of the *Ferula* plant are usually used in the treatment of diseases associated with respiratory infections in humans, and they are used by veterinarians to treat boils of various origins in the animal's body. *Ferula* resins are also used in medicine as an effective lactogenic agent.

In folk medicine of Central Asia and Iran, the gum resin of the smelly *Ferula* is used as an anticonvulsant. Gum resin also acts as a sedative for nervous diseases such as neurasthenia, hysteria, and neuroses.

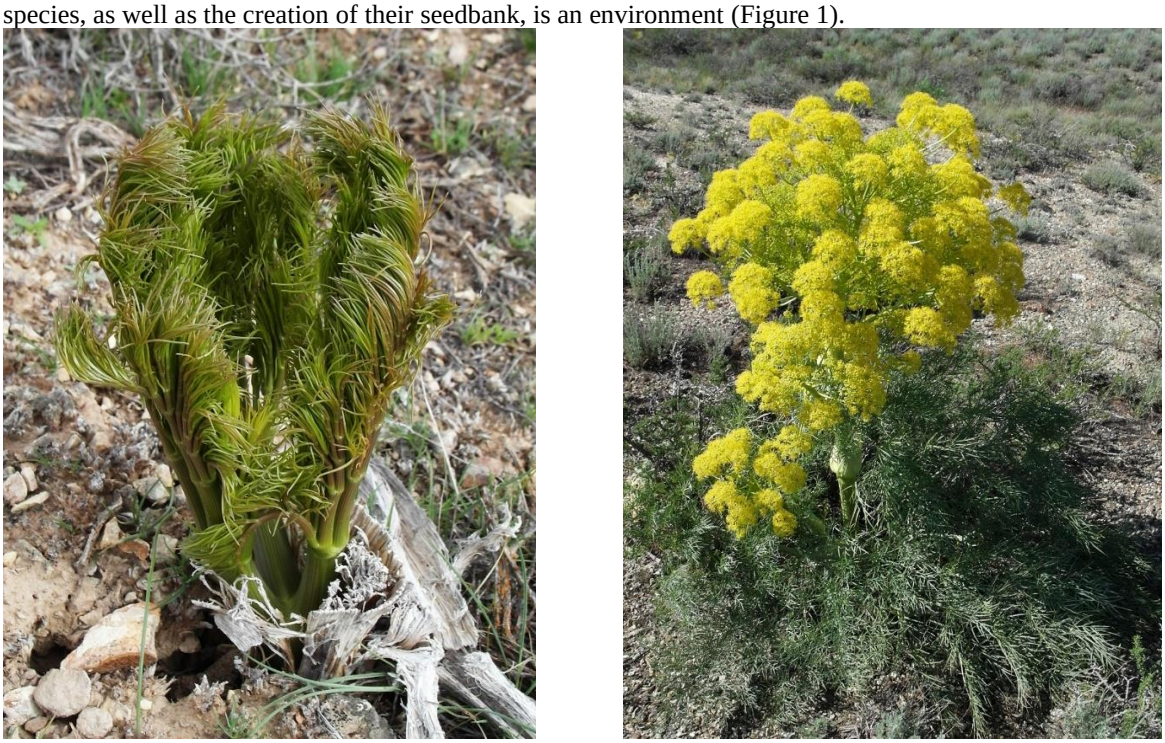
Ferula representatives of the genus are considered a source of medicinal Tar [15], in the countries of the Ancient East, these substances were called ammoniacum, kinna, asaphetida, sapagen, Galban, sumbul and others, and were used in the treatment of various diseases [16]. Currently, up to 4,000 tons of tar is prepared and used for various purposes every year in the countries of the Asian continent - Iran, Afghanistan, India, China, Mongolia and other countries.

To date, many studies have been conducted on the chemical composition of *Ferula varia* as well as its medicinal properties [17, 18]. This in turn requires the breeding of this species as well as their large-scale use.

There has also been research on the distribution of this species in natural plant communities [19, 20, 21]. These studies also provide information about the place and share of the species in the plant community [22]. A number of similar studies are carried out in the arid regions of Uzbekistan. During research, *Nigella sativa* L. and the biological properties of *Linum usitatissimum* species have also been studied and others [23, 24].

2. Materials and Methods

The object of the study is *Ferula varia* (Schrenk) Trautv distributed in Kyzylkum. is. This species is a perennial, monocarpic plant. Considering that the plant gives seeds once in its life, the organization of plantations of this species, as well as the creation of their seedbank, is an environment (Figure 1).



A (Young escape) B (generative individuals)

Figure 1. *Ferula varia* (photo by I.Evdomikov)

The root is thickened, oval, the neck is wrapped in fibers; single or several (4), strong, medium thickness, height about 1 m, branching into a spherical panicle at the top; branches at the bottom are alternate, the upper ones are collected several times in whorls; l. soft, soon fading, glabrous; basal on long, strong, rounded petioles, pl. their

spreading, triangular in outline, segments on long petioles, repeatedly pinnately dissected into narrowly linear-lanceolate lobes, the latter flat, slightly wrapped at the edges, with an average prominent vein, pointed at both ends, 40 mm long, 2.5 mm wide.; stem leaves with a reduced lamina, the upper ones are reduced to one vagina, the upper ones are leathery, oval-lanceolate, deviated from the stem. Umbrellas are different, central sessile or almost sessile, 10-15 (25)-radial, 8-12 cm wide., lateral 2-6, on long legs, except for 1-3 small underdeveloped ones located at the very base of the central umbrellas; umbrellas 13-18-flowered, without a wrapper or with a wrapper of several scaly leaves; cups. without teeth; petals are yellow, oblong-elliptical, narrowly pointed at the top and folded inside, drooping; the base is conical, strongly thickened at the edges, the columns are thickened at the top; semi—fruits are brown, elliptical, flatly compressed, with a wide margin, 8-10 mm long, 4.5-6 mm wide; ribs barely protrude on the surface; tubules in the furrows are single, there are 2 of them on the cleavage side, they are all narrow. It's blooming. V; pl. VI—VII. In clay-sand deserts. — Central Asia: the Aral-Caspian Sea, Balkhash., Kyzylkum. Endemic plants of Central Asia. Described from the desert between the lakes. Kochkan-su and Arys. A type saved in Sankt Peterburg herbarium (Russia).

It is widespread on the rocky slopes of the Kyzyl-Kum relict mountain. The stem is single, rarely there are several, about 1m high, branching. The leaves are soft, glabrous, repeatedly pinnately dissected. The inflorescence is a complex umbrella. The umbrellas are terminal, almost sessile, 10-15 radial. Umbrellas 13-18 are flowered. The mericarpia are elliptical, with blunt filamentous ribs spaced, the tubules in the furrows are single narrow. The root is thickened, oval. The neck is shrouded in waves. It blooms in May, bears fruit in June-July. It is well eaten by all kinds of cattle. The plant has medicinal, essential-oil, fodder and honey-juicy properties.

Uzbekistan is considered geographically and naturally prone to the flow of environmental degradation in terms of climate, with arid (arid) regions occupying about 70% of the total area of Republic. During the market economy, it is important to effectively use the gods of this kind. At the same time, Navoi region is the largest region of our republic, occupying 25% of the total area of our republic (Figure 2.)

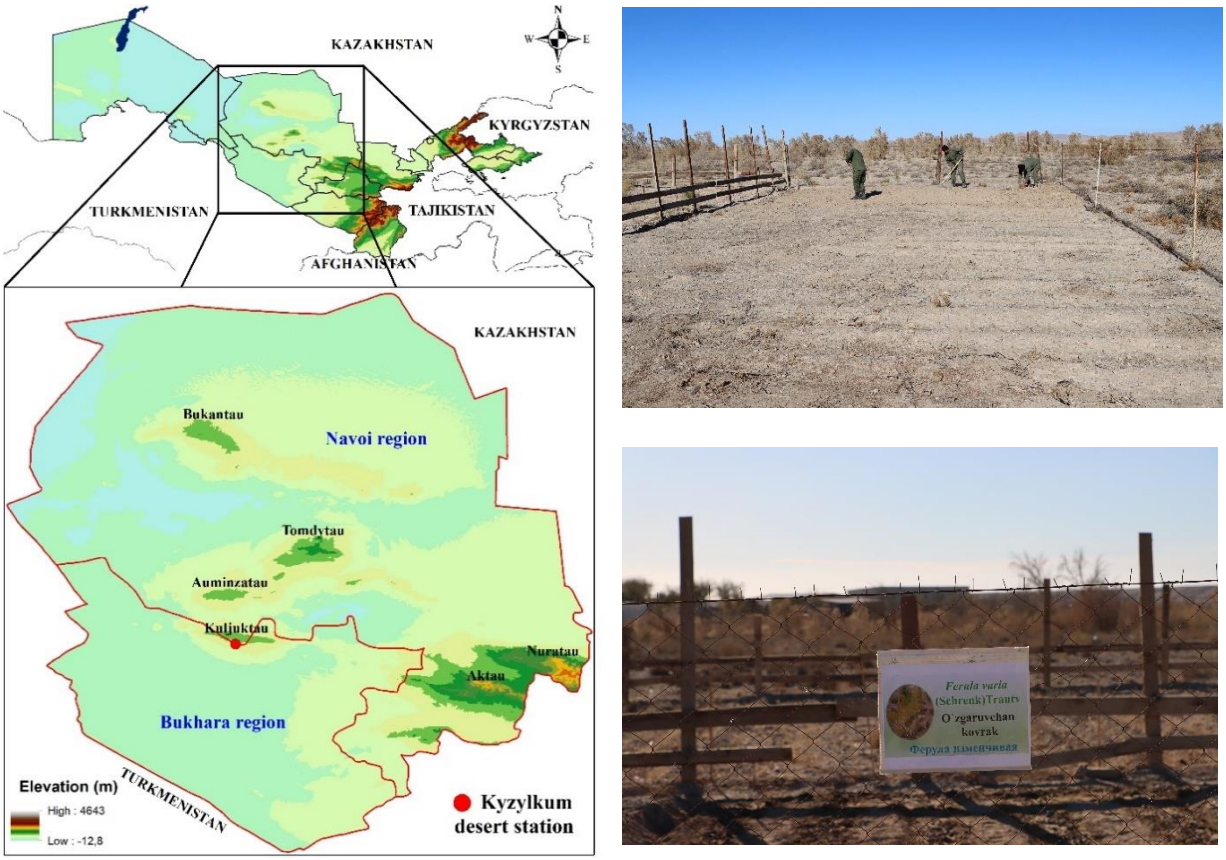


Figure 2. Study area (Kyzylkum desert station)

During the studies, GIPAN hydrogel was used. yavlyalis hydrolyzovannium polyacrylonitrile (GIPAN), formaldehyde, hydrogel, ammophos and NPK. Optimal modes of obtaining water-efficient new types of hydrogels based on GIPAN, which is considered a domestic raw material, have been anicized. One of the most important points of hydrogel in this variety is that they are inexpensive. GIPAN is the name of a hydrogel adopted by local scientists (Figure 3).

A B C D

Figure 3. Hydrogel preparation process (GIPAN)

3. Results and Discussion. Our research work is carried out on the territory of the Navoi region of the Republic of Uzbekistan. The main experiments were carried out on the site of the Kyzylkum Desert station. This area is located in the southwestern Qizilqum desert,around Kuljuktau relict mountain. The result of studies in 2012-2023 shows that in the Uzbek part of the Kyzylkum area, the share of the annual fat content did not exceed 110 mm. This in turn necessitates the development and use of water-saving based technologies.

In technologies based on water conservation, the role of hydrogels is considered important. The introduction of hydrogel into the soil along with seeds is due to the fact that in almost all plants there is an increase in the chances of rapid germination, development and survival of the grass.

In the conditions of Uzbekistan, plants are planted mainly in the autumn and spring season. It is considered one of the traditional methods of our republic. Many results in this regard have been achieved in the cultivation and reproduction of cultivated plants. On the basis of these methods, we also planted plants from their seeds in the autumn and spring seasons.

This in turn allows you to effectively use natural lands and get a lot of harvest in them.

During the studies, *Ferula varia* seeds were planted on the site of the redcurrant Desert station on the basis of various options. Plant seeds were sown in October-November 2023. This, in turn, will be very effective in affecting the amount of oil that is going to be in December-February to the seed being planted (Figure 4).

A B C D

Figure 4. Autumn planting season

Tasks in a similar direction were carried out in February-March 2024. In these studies, plant seeds were planted using Control and hydrogels. The dominant side of the seeds sown in the spring months, in which the period of thinning lasts longer. This condition leads to complete seed germination (Figure 5).

A B C D

Figure 4. Spring planting season

Plant seeds were sown on the basis of various options. With control and hydrogels, 100 seeds were planted in 4 repetitions. Results planted in the fall show that experimentally sown seeds were observed to germinate at around 82-87% as well as around 89-93% of the germination of hydrogel sown seeds. The germination of seeds sown in the autumn season was found in the experiment to be on average 84.25 %, with hydrogel exposure of 90.75%. Alternatively, it was noted that their survival would be higher. It should be noted that the seeds of the plant are very light, and there are cases when they fly under the influence of wind in natural conditions (Table 1).

Table 1. The germination of seeds sown in the autumn season (n-400)

Experience					Medial, %
Sown seeds, pieces	100	100	100	100	
Germination, %	82	87	83	85	84, 25
With hydrogel					Medial, %
Sown seeds, pieces	100	100	100	100	
Germination, %	93	89	90	91	90.75

In the spring season, 70-76% of the seeds sown were observed to germinate experimentally, as well as 77-84% under the influence of hydrogel. At the same time, it was noted that the survival rate of seeds planted in control is low. This is explained by the low amount of fat in the spring months as the main reason. It was observed that the germination of seeds sown in the spring season is slightly lower. According to this, the experiment found that they had 73% germination and 81% exposure to hydrogel.

In combination with this, strong winds regularly blow in the conditions of the Kyzylkum desert. This in turn causes the fertile soil layer and seeds to fly away. It was observed that seeds planted with hydrogel have a high survival rate. Because its content is the amount of moisture, which serves to make the plant recover itself. Data in the literature indicate that hydrogels have been recorded to retain moisture in the soil for 3-4 years.

Table 2. The germination of seeds sown in the spring season (n-400)

Experience					Medial, %
Sown seeds, pieces	100	100	100	100	
Germination, %	70	76	71	75	73
With hydrogel					Medial, %
Sown seeds, pieces	100	100	100	100	
Germination, %	84	82	77	81	81

4. Conclusion. Nowadays, both in modern medicine and traditional medicine, representatives of the *Ferula* range are widely used. Breeding and widespread use of representatives of the category in arid regions is one of the important tasks. Therefore, in regions with arid and water problems, it is necessary to grow such plants and develop their optimal technologies.

There are water scarcity problems in the arid regions of Uzbekistan and the Kyzylkum desert. Water conservation is therefore considered important in these areas.Under natural conditions, plants germinate to the maximum. But their later survival rates are considered very low. In desert conditions, the main reason for this is high temperatures as well as lack of water. Research has shown that Ferula varia seeds are considered from species that need moisture at a certain time. This in turn increases their need for hydrogel. When comparing the germination of seeds sown in spring and autumn, it was noted that the germination and shelf life of seeds sown in autumn is high. This is primarily due to the fact that the seeds have a sufficient period of thinning, as well as the amount of precipitation in the autumn-winter seasons.

Of course, this research is a beginner's test. In the course of several years of research, the optimal planting time and the volume of hydrogels are improved.

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References

1. Delgado M.del M., Roslin T., Tikhonov G., Meyke E., Lo C., E. Gurarie, M. Abadonova, Ozodbek Abduraimov. Differences in spatial versus temporal reaction norms for spring and autumn phenological event. Proceedings of the National Academy of Sciences of the United States of America (PNAS). 2020. P.1-10

2. Kovalenko I, Butenko S, Zhezhkun A, Abduraimov O., Porokhniach I. Trends in the transformation of plant ontogenesis under global climate warming. Estonian Academic Agricultural Society. 2022. Vol.8. Journal of Agricultural Science 2, XXXIII, 410–417 DOI: 10.15159/jas.22.27. 2022.

3. Panahi M., Banasiak L., Piwczynski M., Puchalka R., Kanani M.R., Oskolski A.A., Modnicki D., Milobedzka A., Spalik K. Taxonomy of the traditional medicinal plant genus *Ferula* (Apiaceae) is confounded by incongruence between nuclear rDNA and plastid DNA. Botanical Journal of the Linnean Society, 2018, 188, 173–189.

4. Abduraimov O.S., Wenjun Li., Shomurodov H.F., Ying F. The Main Medicinal Plants in Arid Regions of Uzbekistan and Their Traditional Use in Folk Medicine. Plants, 12 (16), 2950; 2023. DOI: https://doi.org/10.3390/plants12162950.

5. Sahu N., Gupta D., Nautiyal U. Hydrogel: Preparation, Characterization and Applications. Asian Pac. J. Nursing and Health Sci., 2020; 3(1):1-11

6. Peppas NA, Bures P, Leobandung W, Ichikawa H. Hydrogels in pharmaceutical formulations. European Journal of Pharmaceutics and Bio pharmaceutics, 2000;50:27–46

7. Akalin, E., Tuncay, H.O., Olcay, B. & Miski, M. 2020. A new Ferula (Apiaceae) species from southwest Anatolia: *Ferula pisidica* Akalin & Miski. Plants 9(740). doi: 10.3390/plants9060740.

8. Yang, L.; Abduraimov, O.; Tojibaev, K.; Shomurodov, K.; Zhang, Y.-M.; Li, W.-J. Analysis of complete chloroplast genome sequences and insight into the phylogenetic relationships of *Ferula* L. BMC Genom. 2022, 23, 643.

9. Abd El-Razek MH, Ohta S, Ahmed AA, et al. Sesquiterpene coumarins from the Roots of *Ferula asafetida*. Phytochem. 2001; 58: 1289–1295p.

10. Yaqoob U., Nawchoo U. Distribution and Taxonomy of *Ferula* L.: A Review. Research & Reviews: Journal of Botany. Volume 5, Issue 3. 2017. P. 15-23.

11. Kholmatov H.H. The main medicinal plants of Central Asia / H.H. Halmatov, I.A. Kharlamov, P.K. Alimbayeva, M.O. Kareev, I.I. Khaitov. Tashkent: "Medicine", 1984. - 200 p.

12. Vykhodtsev N.V., Nikitina E.V. Wild medicinal plants of Kyrgyzstan / N.V. Vykhodtsev, E.V. Nikitina. –Frunze, 1946. - 72 p.

13. Mustafina F.U., Lee H., Sharipova V.K., Lee A., Kim D.W., Choi M.N., Kim Y.S., Jang J.W. Comparative fruit morphology and its systematic significance in Ferula (Apiaceae) species from different growth habitats. *Flora: Morphology, Distribution, Functional Ecology of Plants*. 2021. 283 (2):151899. doi.org/10.1016/j.flora.2021.151899
14. Utkin A. A. On some ferula and doremals of Turkmenistan and Southern Kazakhstan /A. A. Utkin// Tr. Botan. Institute of the USSR Academy of Sciences, 1938, ser. V, issue 1. - pp. 563-578.
15. Samadi, N., Shahani, S., Akbarzadeh, H., Mohammadi-Motamed, S., Safaripour, E., Farjadmand, F. et al. (2016). Essential oil analysis and antibacterial activity of Ferula assa-foetida L. aerial parts from Neishabour mountains. Research Journal of Pharmacognosy, 3 (3), 35–42. Available at: http:// www. rjpharmacognosy.ir/article_15635.html
16. Kavoosi, G., Tafsiry, A., Ebdam, A. A., Rowshan, V. (2013). Evaluation of Antioxidant and Antimicrobial Activities of Essential Oils from *Carum copticum* Seed and *Ferula assafoetida* Latex. Journal of Food Science, 78 (2), T356–T361. doi: https://doi. org/10.1111/1750-3841.12020
17. Kurimoto Sh., Suzuki K., Okasaka M., Kashiwada Y., Kodzhimatov O., Takaishi Y. New sesquiterpene lactone glucosides from the roots of *Ferula varia.* Phytochemistry Letters. Volume 5, Issue 4, December 2012, Pages 729-733.
18. Mamatkhanova M.A., Khalilov R.M., Syrov V.N., Mamatkhanov A.U., Kotenko L.D., Satimov G.B., Madrakhimov Sh.N. Technology for cinaroside production from the aerial part of *Ferula varia* and evaluation of its hypoazotemic activity. Pharmaceutical Chemistry Journal, 2009. 43(3):160-162
19. Shomurodov H.F., Abduraimov O.S., Adilov B.A. Assessment of the state of *Tulipa lehmanniana* Mercklin populations under the conditions of the Kyzylkum Desert. Arid Ecosystems, 2021, Vol. 11, No. 1, pp. 83–90
20. Saribaeva Sh. U., Shomurodov Kh. F. Abduraimov O.S. Ontogenesis and Ontogenetic Structure of Local Populations of the *Astragalus holargyreus* Bunge (Fabaceae) of the Narrow-Local Endemic of Kyzylkum. Arid Ecosystems, 2022, Vol. 12, No. 1, pp. 78–84
21. Abduraimov O.S., Maxmudov A.V, Kovalenko I, Allamurotov A.L, Mavlanov B.J, Shakhnoza S.U, Mamatkasimov O.T. Floristic diversity and economic importance of wild relatives of cultivated plants in Uzbekistan (Central Asia). Biodiversitas, 24: 1668-1675. 2023. DOI: 10.13057/biodiv/d240340
22. Khamraeva D.T., Bussman R.W., Abduraimov O.S., Rakhimova N.K. Adaptive mechanisms of conservation populations of rare and endemic species of *Kamelinia tianschanica* F.O. Khass & I.I. Malzev in Uzbekistan. Pakistan Journal of Botany 55(3). 2023. DOI:10.30848/PJB2023-3(18).
23. Mahmudov A.V, Abduraimov O.S, Erdonov Sh. B, Allamurotov A.L, Mamatkasimov O.T, Gayibov U.G, Izotova L.Y. Seed productivity of *Linum usitatissimum* L. in different ecological conditions of Uzbekistan. Plant Science Today. 2022; 9(4): 1090–1101.
24. Mahmudov A V, Abduraimov O S, Erdonov Sh. B, Allamurotov A L, Mamatkasimov O T, Gayibov U G, Izotova L Y. Bioecological features of *Nigella sativa* L. in different conditions of Uzbekistan. Plant Science Today. 2022. Vol 9(2): 421–426
25. Akhmedov, A., Rog, I., Bachar, A., Shomurodov H.F., Nasirov, M., Klein, T. Higher risk for six endemic and endangered *Lagochilus* species in Central Asia under drying climate. Perspectives in Plant Ecology, Evolution and Systematics, 48, 125586. 2021. DOI: 10.1016/j.ppees.2020.125586
26. Akhmedov A, Nomozova Z, Umurzakova Z, Turdiboev O, Atayeva S,Jumayev N. 2022. Assessment of the current condition of populations of the red list species Salvia submuticaBotsch. & Vved. (Lamiaceae Lindl.) in Nuratau mountain ridge, Uzbekistan. Ekológia (Bratislava)41(4):322-328. DOI: 10.2478/eko-2022-0033.
27. Akramov DK, Mamadalieva NZ, Porzel A, Hussain H, Dube M, Akhmedov A, Altyar AE, Ashour ML, Wessjohann LA. 2021. Sugar-containing compounds and biological activities of Lagochilus setulosus. Molecules 26(6):1755. DOI: 10.3390/molecules26061755.