

Ecological Analysis of Species of the Genus *Ferula* L., Distributed in Navoi Region (Uzbekistan)

Abduraimov S. Ozodbek^{1*}, Shomurodov F. Habibullo¹, Beshko Yu. Natalya¹,
Maxmudov V. Azizbek¹, Mavlanov J. Bekzod¹, Allamurotov L. Akmal¹, Sharipova K. Vasila¹,
Mamatkasimov T. Odilbek¹, Abduraimov S. Azizbek², Giyasiddinov L. Abduaziz³

¹Institute of Botany Academy Science of Republic of Uzbekistan, Tashkent, Uzbekistan

²Department of Medicinal Plants and Botany, Faculty of Natural Science, Gulistan State University, Gulistan, Uzbekistan

³Namangan Institute of Engineering and Technology, Namangan, Uzbekistan

Email: *ozodbek88@bk.ru

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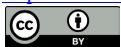
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Abstract

Ferula L. is a perennial herbaceous plant belonging to the family Apiaceae Lindl. (Umbelliferae). Our research was carried out on the territory of Navoi region. The article presents an ecological analysis of the species of the *Ferula* L. in Navoi region. The species of genus *Ferula* mostly grows in mountainous regions and some are distributed in arid climates. According to that 15 species of the genus were found in the Navoi region, most of these species are considered to be plants that contain tar as well as have a strong medicinal property. In various parts of the world, different species of *Ferula* have been used in traditional medicine. In the course of studies, it was found that the species has medicinal, essential-oil, honey-juicy, nutritious, and fodder properties. According to ecological analysis, the genus *Ferula* grows Rocky, gravelly, fine-grained slopes and ridges of mountains, scree, rocks, outcrops of variegated rocks, rocky slopes, sandy, clay and gravelly deserts, foothill plains, fine-grained slopes. Considered rare, *Ferula kyzylkumica* Korovin is listed in the Red Book of the Republic of Uzbekistan, while *Ferula nuratavica* Pimenov is an endemic plant of the Aktau ridge.

Keywords

Ferula L., Ecological, Medicinal, Navai Region, Uzbekistan

1. Introduction

Modern approaches to environmental protection should be based on the rational

use of natural resources [1]. An analysis of the dynamics of anthropogenic effects on the natural environment shows that the “prohibitive” approach is both ineffective and inhumane and cannot solve current and everyday environmental problems. The relationship between human activities and conservation policies should be built on the results of systematic scientific research on the state of biodiversity [2].

Environmental protection and rational use of biological resources are the basis for successful socio-economic development of any state [3] [4]. The Republic of Uzbekistan has a unique landscape and biological diversity with a large number of endemic, threatened and economically valuable species of plants and animals, which represent not only national, but also global heritage. The territory of Uzbekistan is part of the key ecological regions of our planet, the study and protection of which are of primary priority. With the acquisition of independence by the Republic of Uzbekistan and accession to the number of States parties to the UN Convention on Biological Diversity (1992), information about the flora and fauna of the country has become especially relevant.

Currently, there is a lot of research on natural medicinal plants and their widespread use [5]. In the process, genus of *Ferula* L. plays an important role [6] [7]. One of the famous species of *Ferula* is used in Iranian traditional medicine for the treatment of digestive diseases, nervous problems and some reproductive system disorders such as decreased libido [8].

Representatives of this category are distributed in large numbers on Earth. *Ferula* L., a perennial single- or multi-bearing herb in the family Apiaceae, contains approximately 213 species mainly distributed in the Mediterranean region of southern Europe, northern Africa, Iran, Afghanistan, Central Asia, Siberia, Russia, India, and Pakistan [9]. The majority of the *Ferula* plants have a pungent odor and can be used for different purposes [10] [11].

Many taxonomic studies have been conducted on the genus *Ferula*. Boissier classified the genus *Ferula* species grown in the Iran-Turanian region into three sections based on the shape of their petals and the number of their vittae: *Peucedanoides* Boiss. *Scrodosma* Bunge and *Euferula* Boiss [12] [13] [14]. 106 species are found in the CIS countries, 105 species in Central Asia, 63 species in Uzbekistan, more than 50 species in Western Tyan-Shan, about 60 species in the Pamir-Alai range, and 33 species in the western Pamir-Alai range [10].

Ferula L. representatives of the genus were considered a source of medicinal tar, from time immemorial in the countries of the East, these substances were called ammoniacum, kinna, asafetida, sapagen, Galban, sumbul and other names and were used in the treatment of various diseases [15] [16] [17]. Currently, up to 4000 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 [18] [19].

Ferula L. in the CIS countries, systematics, carpology, ecology and distribution of some species of the genus E.P. Korovin (1947), M.G. Pimenov *et al.* (1978) and V.M. Vinogradova (1990) [20] featured in the work of Safina (2012) and oth-

ers [10] [21].

In this direction, a lot of research has been carried out in Uzbekistan [22] [23] [24] [25] [26]. Much research has been done, especially on the populations of species and the factors affecting them [27] [28] [29] [30] [31].

Despite the fact that there is a lot of research on the genus, *Ferula* L., which is distributed in the Navoi region, there has been no research on modern ecological analyses of the species.

2. Object and Methods of Research

In the performance of the study classical botanical research methods were used. The main method, used during the field research was route reconnaissance. The laboratory processing of the initial material was performed in strict accordance with all requirements, and the herbarium samples were stored in the National herbarium (TASH). Species of the genus *Ferula* L. is distributed in Navoi region (Uzbekistan).

3. Study Area

Navoi region is located in the central part of the Republic of Uzbekistan, in physical and geographical terms, it includes most of the Kyzylkum desert (including most of the remnants), the western half of Lake Aydarkul, the western part of the Nuratinsky and Zirabulak-Ziadin sky mountains, part of the valley of the Zeravshan River in its lower reaches and a small area in the northwest of Karnabchul.

Navoi region occupies the 2nd place in terms of area (110.8 thousand km², about 24.8% of the country's territory), while due to its natural conditions, this vast region is relatively sparsely populated (13th in terms of population and 14th in terms of population density). Navoi region is rich in minerals and is one of the most industrially developed regions of the Republic of Uzbekistan, there are large mining, machine-building, chemical enterprises and enterprises of other industries. Irrigated arable land occupies less than 0.1% of the area of the region and is concentrated in the Zeravshan and Nurata valleys, the rest of the agricultural land is used mainly as pastures. The region is divided into 8 administrative districts: Kanimeh, Karmana, Kyzyltepa, Navbakhor, Nurata, Tamdy, Uchkuduk and Khatyrchi. There are no nature reserves and national parks within the region (Figure 1).

Botanically and geographically, the territory of Navoi region includes parts of 7 districts: Nurata and Aktau districts of Nurata district and Zirabulak-Ziadin district of Kuhistan district of mountain middle asian province, Kyzylkum and Kyzylkum outlier districts of Kyzylkum district, lower-Zeravshan and Karshi-Karnabchul districts of Bukhara district of Turan province [32].

The territory, which is part of the Nurata district of the Nurata region, includes the western part of the Nuratau ridge (starting from the Sentyabsai tract). The absolute heights of the terrain on the Nuratau ridge at the junction of the

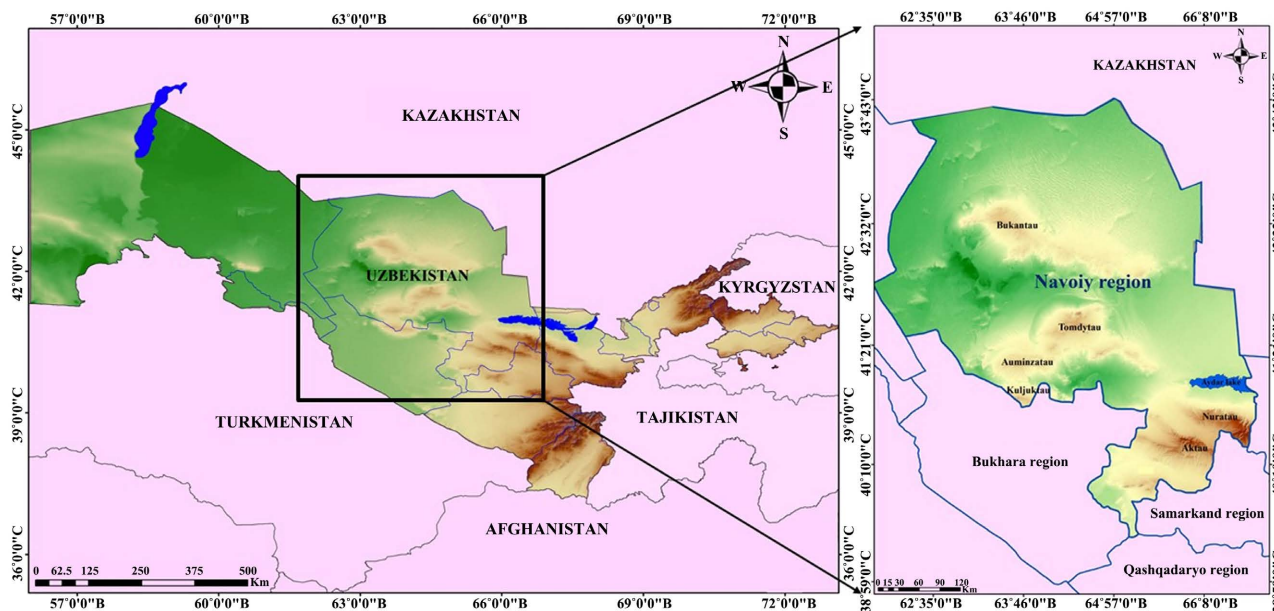


Figure 1. Study area.

Navoi and Samarkand regions reach 2136 m (Karchegai, the second highest peak of Nuratau), and gradually decrease to the west to 400 m above sea level at the extreme western tip of the ridge. The northern slope is very rocky, it has a complex, dissected relief, with numerous outcrops of bedrock, deep valleys of mountain rivers, temporary watercourses and dry channels. The watershed part of the ridge to the west of the Sentyabsai and Sobsai tracts is an ancient leveling surface (plateau) located at an altitude of about 1600 m above sea level and gradually decreasing from east to west. There is a small freshwater lake Fazilman with an unstable hydrological regime, as well as the sources of many streams that form the surface and underground flow of the Nuratau ridge, quite large areas are plowed for bogara. The southern slope of Nuratau is rather gentle, slightly dissected, with a soft relief, gradually descends to the intermountain Nurata Valley, dividing into the northern and southern branches of the Nurata mountains.

4. Result and Discussion

However, sufficient attention was not paid to the distribution of medicinal species of the genus *Ferula* containing biologically active substances in the resin, the identification of the localization of secretory resin receptacles and the determination of the periods of accumulation of medicinal resin. In the improvement measures on measures to radically improve the management system of the pharmaceutical industry, the task “development of recommendations for local reproduction of medicines” is noted. Based on these tasks, to organize research work aimed at substantiating the localization of secretory resin receptacles in vegetative and generative organs of species common in different ecological conditions of the genus *Ferula*, identification of the resin composition and introduction into production is important. During the studies, it was found that 15 spe-

cies of the genus occur on the territory of the Navoi region. It turned out that all of these species have a perennial life form (Table 1, Figure 2).

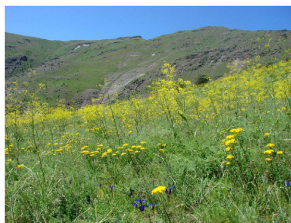
We will talk about some of these species.

It is known that more than 1.5 million herbarium specimens are stored in the National Herbarium of the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan. Among them, representatives of the *Ferula* genus also occupy an important place (Figure 3).

1) *F. diversivittata* Rgl. et Schmalh. is a monocarp plant. The root is cylindrical. The stem goes up to 1.5 m, the joint is swollen, branches from the middle or below into a wide oval complex whorl, the branches are arcuate, the lower

Table 1. Genus of *Ferula* L., distributed in Navoi region.

1 <i>Ferula angreni</i> Korovin	9 <i>Ferula litwinowiana</i> Koso-Pol.
2 <i>Ferula diversivittata</i> Regel & Schmalh.	10 <i>Ferula mollis</i> Korovin
3 <i>Ferula dshizakensis</i> Korovin	11 <i>Ferula nuratavica</i> Pimenov
4 <i>Ferula foetida</i> (Bunge) Regel	12 <i>Ferula ovina</i> (Boiss.) Boiss.
5 <i>Ferula karelinii</i> Bunge	13 <i>Ferula penninervis</i> Regel & Schmalh.
6 <i>Ferula kokanica</i> Regel & Schmalh.	14 <i>Ferula schtschurowskiana</i> Regel & Schmalh.
7 <i>Ferula kyzylkumica</i> Korovin	15 <i>Ferula varia</i> (Schrenk) Trautv.
8 <i>Ferula lehmannii</i> Boiss.	



Ferula angreni Korovin (photo by Beshko)



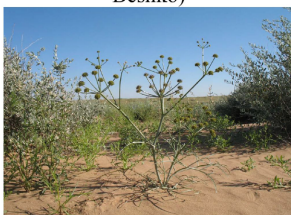
Ferula litwinowiana Koso-Pol. (photo by Beshko)



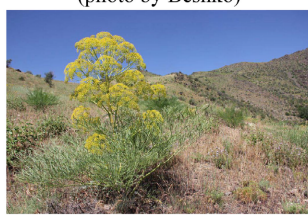
Ferula diversivittata Regel & Schmalh. (photo by Beshko)



Ferula foetida (Bunge) Regel (photo, by Beshko)



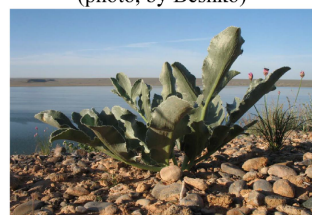
Ferula karelinii Bunge (photo Kolbintsev)



Ferula penninervis Regel & Schmalh. (photo by Beshko)



Ferula kokanica Regel & Schmalh. (photo Gaziyev)



Ferula schtschurowskiana Regel & Schmalh. (photo Kolbintsev)



Ferula varia (photo by Kolbintsev)



Ferula lehmannii Boiss. (photo by Smelyanskiy)



Ferula ovina (Boiss.) Boiss. (photo by Kolbintsev)



Ferula kyzylkumica Korovin (photo by Beshko)

Figure 2. Genus of *Ferula* L.

*Ferula dshizakensis* Korovin*Ferula mollis* Korovin*Ferula nuratavica* Pimenov**Figure 3.** Species of *Ferula* L., held at the TASH Foundation.

ones are alternately, the upper ones are annular, the root throat has a short and strong band with three petals, The last ends are large, 15 × 6 cm long and wide, Elliptic and oblong in shape, veined at the base, almost. The umbrella is different, the end is 15 - 20 (30) light, very short nodules, up to 8 cm wide, the next ones are long nodules, Collected in 2 - 6 places. Umbrellas are located 15 - 20-flowered, winding-leaved, lanceolate petals. The inflorescences are triangular-lanceolate-toothed. The petals are yellow, oval, bent inward, 1.2 mm long, with an expanded edge as the columnar underside rises. The fruits are ovate, flattened, 10 - 6 mm long and wide, the ribs are filamentous, the channels in the Egate are wider, single, and 6-lobed on the lateral ones. Blooms in May, fruiting in June.

2) *F. kokanica* Rgl. et Schmalh. is a monocarp plant. The roots are sometimes creamy. The stem is medium-thick, up to 1.0 m long, the upper part is branched in an oval-shaped complex shingle, the branches are arranged in a ring, the lower ones are located alternately. The leaves are whitish, quickly wilted, feathery on the underside, the root-throat ones are three-petaled, longer-banded, the joints are feathered, the end ends are oblong-ellipsoid, the base is rooting, the tip is rounded, sometimes deeply incised, with a sharp Sawtooth. Length and width 7 - 9 × 2 - 3 cm, only the lower ones of the stem are leafy, the upper ones are Oval, consisting entirely of a branch that wraps around the stem. The umbrella is different, the end is more pointed, with 8 - 16 rays, the width is 5 - 8 cm, the next ones are located from 1 - 2 holes, the end ends with a sobon. Umbrellas are located 10 - 15 (25) flowers. The inflorescence is short-toothed. The petals are oblong-ovate, yellow inward-recurved, 2 mm long. The fruits are yellow, hairy, ovate in length and width 10 × 5 mm, filamentous ribs, the upper

surface of the canals is hairy, each ovary 4 - 5, the lateral ones 10. Blooms in May, June, fertilizes in June, July.

3) *F. foetida* (Bunge) Regel is a monocarp. The root is large, up to 1.5 m of the soil, cylindrical, the main root of the colon penetrates to a depth of 0.5 m. The diameter of the root throat goes up to 15 - 20 (30) cm. The stem is erect growing, slightly hollow inside, reaching 1.0 - 1.5 m, branching from the top, often forming a single (sometimes 2 - 3) generative branch, which blooms and fertilizes once every 7 - 9 years. The leaves are soft, quickly wilted, glabrous above and slightly hairy below, the stem-throat leaves are short, creamy-banded, the stem leaves are small, forming a Nov. The shape of the leaves on the root collar is pyramidal, the leaf plate is double-cut, the Leaf segments are lanceolate, and the edges are flat, reaching 14.0 - 18.0 cm in length and 5.0 - 7.0 cm in width. The leaves, which are located on the STEM, are crushed upward, the most three consist only of a leaf stem. Especially in *Ferula foetida* (Bunge) Regel forms very large natural populations in desert regions of Navoi region (Figure 4).

The height of the generative branch is up to 45.0 - 50.0 cm, the paracladium (complex umbrellas) and the umbrellas in them are formed, the Central and side umbrellas. The tuber of the plant reaches its maximum size, reaching a height of 18.0 - 25.0 cm, and a width of 15.0 - 20.0 cm. They number 3, sometimes 4. The generative branch forms a complex umbrella. Each branch has 20 to 35 lateral

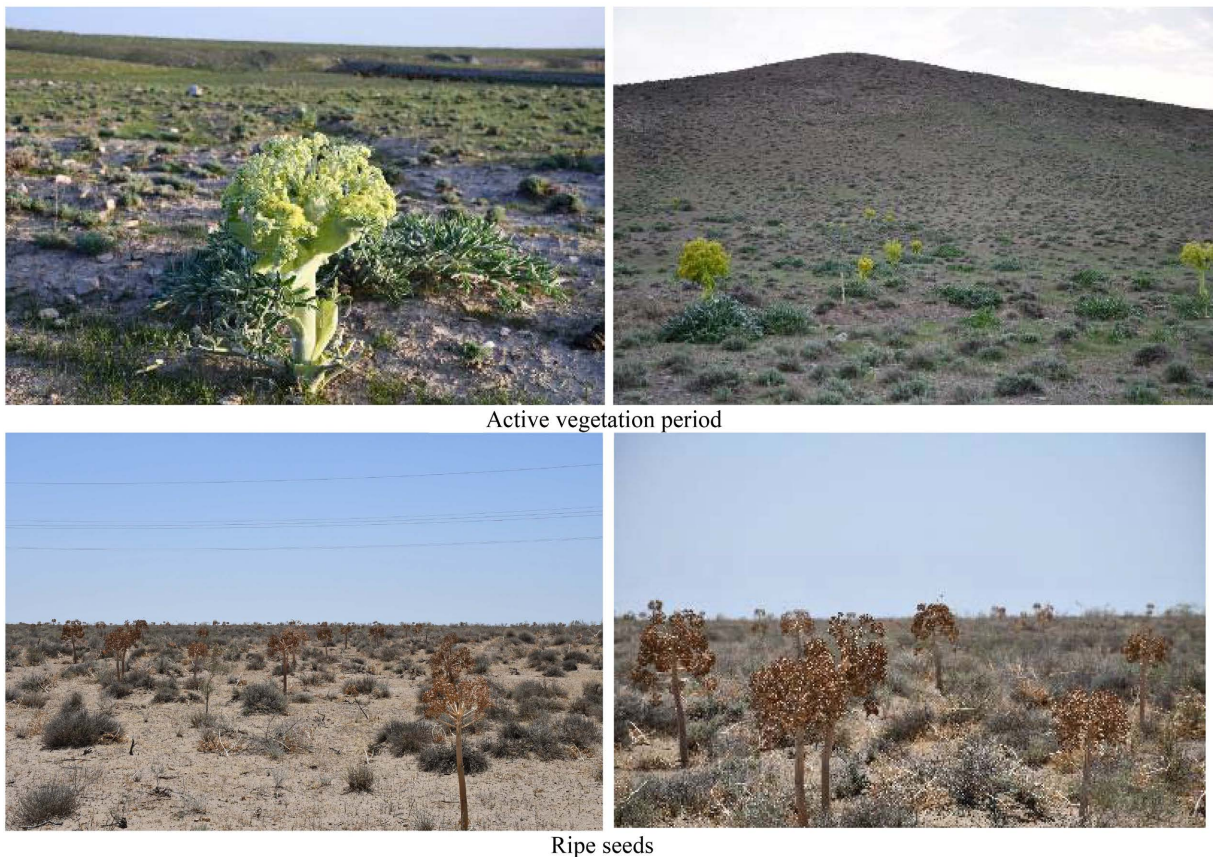
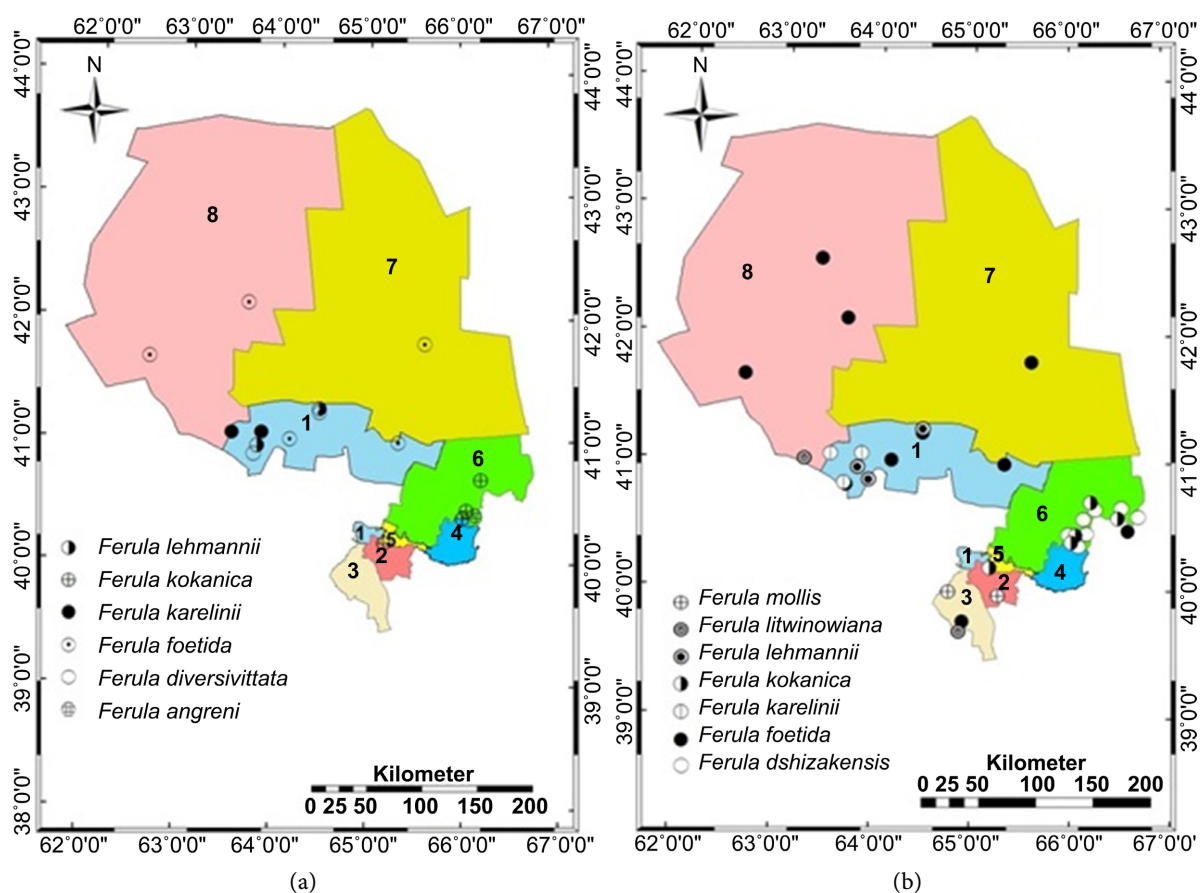


Figure 4. Natural populations of *Ferula foetida* (Navai region, Uzbekistan).

bulbs. Each paracladid contains a central palate and 2 - 3 much longer (3.0 - 5.0 cm) side palate. Each of the bulbs in the bulbs produces 9 - 11 flowers. It blooms in March, April and fertilizes at the end of May.

F. penninervis Rgl. et Schmalh. Polycarp. The stem is 70 - 100 cm high, robust, thick, sometimes singly, and smooth, only in the younger period the Leaf is serrated, the third branching above is a wide oval complex shingle, and from the bottom it is umbrella-shaped. The leaves on the root throat are rhombic-ovate, three-fold virulent, and quickly wilted, the primary segments are multifaceted (6), with a lanceolate linear cut. The umbrella is hemispherical and diverse, with 10 - 15 flowers, without wraps. The flowers are yellow, with oblong oval-shaped tadpoles and short triangular petals. The fruits are oblong-ovate 10 - 13 × 6 long and wide. In the egats, the channels are one wide, and the ones on the sides are one wide. Blooms in June, fertilizes in July and August.

Most of these species have been found to occur in the mountain and mountain areas of the province. But it should be noted that most of the territory of the region consists of desert regions. These species are not evenly distributed on the territory of the region. Specifically *Ferula angreni* Korovin, *Ferula dshizakensis* Korovin, *Ferula kokanica* Regel & Schmalh., *Ferula nuratavica* Pimenov, *Ferula ovina* (Boiss.) Boiss., *Ferula penninervis* Regel & Schmalh. and *Ferula szczurowskiana* Regel & Schmalh. The species is mostly common in the mountain and mountain deities of the province. The distribution of certain species is more extensive.



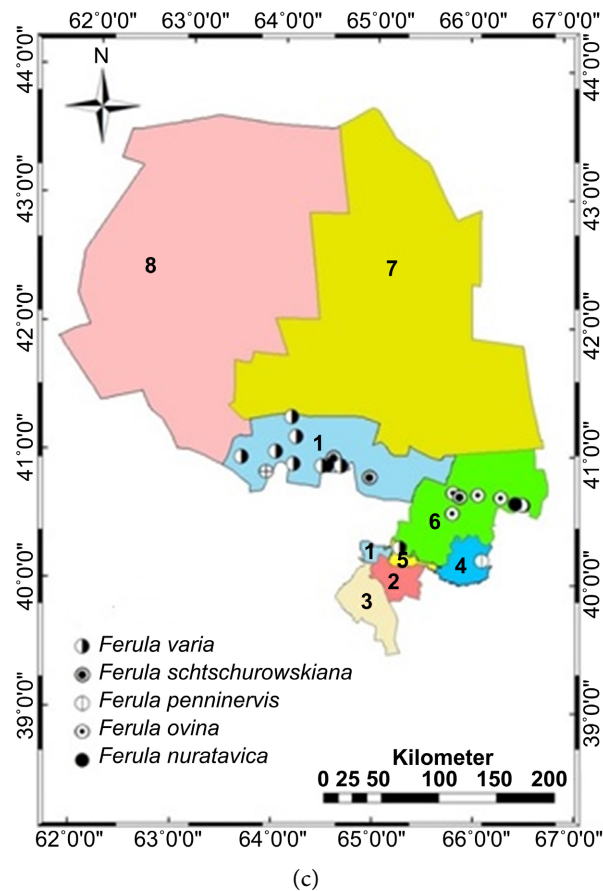


Figure 5. Genus of *Ferula* L., distributed in Navoi region (TASH data).

Some species are mostly common in desert regions of the province. These are *Ferula foetida* (Bunge) Regel, *Ferula karelinii* Bunge, *Ferula kyzylkumica* Korovin, *Ferula lehmannii* Boiss., *Ferula litwinowiana* Koso-Pol. and *Ferula varia* (Schrenk) Trautv. types are considered.

During the studies, herbariums held at the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan (TASH) were analyzed. This information allows monitoring of species. The results of the studies show that the main distribution area of the species is around Nurata Mountain (Figure 5).

5. Conclusions

Navoi is the largest region in Uzbekistan. The plant diversity of the area is considered to be very high. *Ferula* L. species of the genus has been regularly used by the indigenous population for several centuries. In turn, the distribution of species as well as their natural reserves necessitates the analysis of the correct data.

The result of research in Navoi region shows that *Ferula* L., it was noted that 15 species of the genus occur. These species are not evenly distributed on the territory of the region. According to ecological analysis, the genus *Ferula* grows Rocky, gravelly, fine-grained slopes and ridges of mountains, scree, rocks, outcrops of variegated rocks, rocky slopes, sandy, clay and gravelly deserts, foothill

plains, fine-grained slopes. Considered rare, *Ferula kyzylkumica* Korovin is listed in the Red Book of the Republic of Uzbekistan, while *Ferula nuratavica* Pimenov is an endemic plant of the Aktau ridge. The main areas of distribution of the species correspond to the mountain and mountain areas. Local residents have been using the leaves and tar of this species for several years.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Khojimatov, O.K., Bussmann, R.W. and Khamraeva, D.T. (2021) Some Aspects of Morphobiology, Conservation of Resource Potential, Crop Cultivation and Harvesting of Raw Materials of Promising *Ferula* Species. *Ethnobotany Research & Applications*, **22**, 1-8. <https://doi.org/10.32859/era.22.31.1-8>
- [2] Khamraeva, D.T., Khojimatov, O.K. and Uralov, A.I. (2019) Rost i razvitie *Ferula* tadshikorum Pimenov v usloviyakh introdukcii. *Acta Biologica Sibirica*, **5**, 172-177. (In Russian). <https://doi.org/10.14258/abs.v5.i3.6588>
- [3] Jenkins, C.N. and Van Houtan, K. (2016) Global and Regional Priorities for Marine Biodiversity Protection. *Biological Conservation*, **204**, 333-339. <https://doi.org/10.1016/j.biocon.2016.10.005>
- [4] Joppa, L.N., Roberts, D.L., Myers, N. and Pimm, S.L. (2011) Biodiversity Hotspots House Most Undiscovered Plant Species. *Proceedings of the National Academy of Sciences of the United States of America*, **108**, 13171-13176. <https://doi.org/10.1073/pnas.1109389108>
- [5] Abduraimov, O.S., Li, W.J., Shomurodov, H.F. and Feng, Y. (2023) The Main Medicinal Plants in Arid Regions of Uzbekistan and Their Traditional Use in Folk Medicine. *Plants*, **12**, Article 2950. <https://doi.org/10.3390/plants12162950>
- [6] Safina, L.K. and Pimenov, M.G. (1990) Carpology of the Species of Type Subgenus of the *Ferula* and Some Problems of Their Systematics. *Feddes Repertorium*, **101**, 135-151. <https://doi.org/10.1002/fedr.19901010305>
- [7] Sharipova, V.K. (2017) Comparative Analysis of the Fruit Pericarp Structure of the Desert and Mountain Species of *Ferula* L. (Apiaceae Lindl.). *American Journal of Plant Sciences*, **8**, 2013-2020. <https://doi.org/10.4236/ajps.2017.89134>
- [8] Iranshahy, M. and Iranshahi, M. (2011) Traditional Uses, Phytochemistry and Pharmacology of Asafoetida (*Ferula assa-Foetida* Oleo-Gum-Resin)—A Review. *Journal of Ethnopharmacology*, **134**, 1-10. <https://doi.org/10.1016/j.jep.2010.11.067>
- [9] Plants of the World Online (POWO) (2023) *Ferula* L. <https://powo.science.kew.org/taxon/30105171-2#publications>

- [10] Yang, L., Abduraimov, O., Tojibaev, K., Shomurodov, K., Zhang, Y.M. and Li, W.J. (2022) Analysis of Complete Chloroplast Genome Sequences and Insight into the Phylogenetic Relationships of *Ferula* L. *BMC Genomics*, **23**, Article No. 643. <https://doi.org/10.1186/s12864-022-08868-z>
- [11] Yaqoob, U. and Nawchoo, I.A. (2016) Distribution and Taxonomy of *Ferula* L.: A Re View. *Research & Reviews. Journal of Botany*, **5**, 15-23.
- [12] Piwczynski, M., Wyborska, D., Gołębiewska, J. and Puchałka, R. (2018) Phylogenetic Positions of Seven Poorly Known Species of *Ferula* (Apiaceae) with Remarks on the Phylogenetic Utility of the Plastid *trnH-psbA*, *trnS-trnG*, and *atpB-rbcL* Intergenic Spacers. *Systematics and Biodiversity*, **16**, 428-440. <https://doi.org/10.1080/14772000.2018.1442374>
- [13] Boissier, E. and Buser, R. (1872) *Flora Orientalis: Sive, Enumeratio Plantarum in Oriente a Graecia et Aegypto Ad Indiae Fines Hucusque Observatarum*. H. Georg, Basileae.
- [14] Tuncey, H.O., Akalin, E., Dogru-Koca, A., Erucar, F.M. and Miski, M. (2023) Two New *Ferula* (Apiaceae) Species from Central Anatolia: *Ferula turcica* and *Ferula latalata*. *Horticulturae*, **9**, Article 144. <https://doi.org/10.3390/horticulturae9020144>
- [15] Amalraj, A. and Gopi, S. (2017) Biological Activities and Medicinal Properties of *Asafoetida*: A Review. *Journal of Traditional and Complementary Medicine*, **7**, 347-359. <https://doi.org/10.1016/j.jtcme.2016.11.004>
- [16] Ghasemi, Z., Rezaee, R., Aslani, M.R. and Boskabady, M.H. (2021) Anti-Inflammatory, Anti-Oxidant, and Immunomodulatory Activities of the Genus *Ferula* and Their Constituents: A Review. *Iranian Journal of Basic Medical Sciences*, **24**, 1613-1623.
- [17] Kurzyna-Młynik, R., Oskolski, A.A., Downie, S.R., Kopacz, R., Wojewódzka, A. and Spalik, K. (2008) Phylogenetic Position of the Genus *Ferula* (Apiaceae) and Its Placement in Tribe Scandiceae as Inferred from nrDNA ITS Sequence Variation. *Plant Systematics and Evolution*, **274**, 47-66. <https://doi.org/10.1007/s00606-008-0022-2>
- [18] Panahi, M., Banasiak, I., Piwczyński, M., Puchałka, R., Kanani, M.R., Oskolski, A.A., Modnicki, D., Miłobędzka, A. and Spalik, K. (2018) 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*, **188**, 173-189. <https://doi.org/10.1093/botlinnean/boy055>
- [19] Roaa, M.H. (2020) A Review Article: The Importance of the Major Groups of Plants Secondary Metabolism Phenols, Alkaloids, and Terpenes. *International Journal for Research in Applied Sciences and Biotechnology*, **7**, 354-358.
- [20] Pimenov, M.G. and Leonov, M.V.E. (1993) *The Genera of the Umbelliferae: A Nomenclator*. 2nd Edition, Royal Botanic Gardens, London, 8-21.
- [21] Mohammadhosseini, M., Venditti, A., Sarker, S.D., Nahar, L. and Akbarzadeh, A. (2019) The Genus *Ferula*: Ethnobotany, Phytochemistry and Bioactivities—A Review. *Industrial Crops and Products*, **129**, 350-394. <https://doi.org/10.1016/j.indcrop.2018.12.012>
- [22] Mavlanov, B.J., Mahmudov, A.V., Allamuratov, A.L., Mamatkosimov, O.T. and Abduraimov, O.S. (2021) Bioclimatic Modeling of the Potential Distribution of the Western Tien-Shan Endemic *Tulipa kaufmanniana* Regel (Uzbekistan, Kazakhstan). *American Journal of Plant Sciences*, **12**, 1468-1477. <https://www.scirp.org/journal/> <https://doi.org/10.4236/ajps.2021.1210104>
- [23] Abduraimov, O.S., Mamatkulova, I.E. and Mahmudov, A.V. (2023) Structure of Local Populations and Phytocoenotic Confinement of *Elwendia persica* in Turkestan Ridge, Uzbekistan. *Biodiversitas*, **24**, 1621-1628. <https://doi.org/10.13057/biodiv/d240334>

- [24] Abduraimov, O.S., Maxmudov, A.V., Kovalenko, I., Allamurotov, A.L., Mavlanov, B.J., Shakhnoza, S.U. and Mamatkasimov, O.T. (2023) Floristic Diversity and Economic Importance of Wild Relatives of Cultivated Plants in Uzbekistan (Central Asia). *Biodiversitas*, **24**, 1668-1675. <https://doi.org/10.13057/biodiv/d240340>
- [25] Xu, X.H., Li, W.J., Abduraimov, O.S., Shomurodov, K.F. and Ni, S. (2020) *Thesium longiperianthium* (Santalaceae), a New Replacement Name for *T. brevibracteatum* P.C.Tam. *Biodiversity Data Journal*, **8**, e59007. <https://doi.org/10.3897/BDJ.8.e59007>
- [26] Abduraimov, O.S., Shomurodov, H.F. and Daniyarov, S.A. (2017) Distribution Pattern and State of Coenotic Population of *Tulipa lehmanniana* Merckl. in Kyzylkum Desert Conditions (Uzbekistan). *American Journal of Plant Sciences*, **8**, 288-296. <https://doi.org/10.4236/ajps.2017.82020>
- [27] Abduraimov, O.S., Shomurodov, H.F. and Daniyarov, S.A. (2018) The Current State of Cenopopulation of *Tulipa micheliana* Hoog in Uzbekistan. *American Journal of Plant Sciences*, **9**, 1725-1739. <https://doi.org/10.4236/ajps.2018.98125>
- [28] Shomurodov, H.F., Abduraimov, O.S. and Adilov, B.A. (2021) Assessment of the State of *Tulipa lehmanniana* Mercklin Populations under the Conditions of the Kyzylkum Desert. *Arid Ecosystems*, **11**, 83-90. <https://doi.org/10.1134/S2079096121010133>
- [29] Abduraimov, O.S., Shomurodov, H.F., Daniyarov, S.A. and Mamatkasimov, O.T. (2020) Distribution and Current State of Rare and Endangered Tulips (Liliaceae) Arid Zones of Uzbekistan. *American Journal of Plant Sciences*, **11**, 736-744. <https://doi.org/10.4236/ajps.2020.115053>
- [30] Khayitov, R.S., Shomurodov, H.F., Abduraimov, O.S. and Berdaliev, A.A. (2021) Phytocenotic Characteristics *Acanthophyllum cyrtostegium* Vved. (Caryophyllaceae) Distributed in Bukhara Region (Uzbekistan). *American Journal of Plant Sciences*, **12**, 1036-1042. <https://doi.org/10.4236/ajps.2021.127071>
- [31] Shomurodov, H.F., Khayitov, R.S., Saribaeva, S.U. and Abduraimov, O.S. (2021) Assessment of the State of *Onobrychis tavernierfolia* Stocks ex Boiss. (Fabaceae) Cenopopulations Southwestern Kyzylkum. *American Journal of Plant Sciences*, **12**, 1043-1050. <https://doi.org/10.4236/ajps.2021.127072>
- [32] Tojibaev, K.S., Beshko, N.Y., Popov, V.A., Jang, C.G. and Chang, K.S. (2017) Botanical Geography of Uzbekistan. Korea National Arboretum, Pocheon.