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Ontogenesis of *Ferula kyzylkumica Korovin (Apiaceae) the Relict Mountains of Eastern Kyzylkum* (Uzbekistan)

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Abstract: ***The article studies the ontogenesis of Ferula kyzylkumica Korovin - a rare endemic relict mountains Kyzylkum, listed in the Red Book of the Republic of Uzbekistan. We describe 3 age periods: virginal, generative, senile. Duration ontogeny in vivo for more than 35 years.***

Keywords: ontogenesis, age structure, *Ferula kyzylkumica*, relict mountain, Kyzylkum desert

1. Introduction

Ferula L. - one of the largest and most polymorphic genera of the family Apiaceae, which includes more than 180 species [1]. They are most common on the territory of Central Asia and Kazakhstan - one of the centers of formation of the genus, is talking about diversity, a high percentage of endemic species. Stand mountain views, most of them concentrated in the lower and middle mountain belts, in the short grass semisavannas formations. Among the interesting species of mountain and desert views, constituting one of the characteristic elements of the landscape of Asian deserts. They meet on the plains of sand and clay to quite considerable heights in the Tien Shan. Some endemic species are confined to specific substrates - variegated, especially gypsum sandstones and clays [2]. In practical terms, the genus of *Ferula* are known as very good, often essential food plants; as medicinal plants of traditional oriental medicine, having great promise as a source of therapeutic drugs and as aromatic, essential-oil plants. Some species of *Ferula* in Central Asia in the recent past have been used as food plants (*Ferula karelinii*, *F. sibirica*, *F. dubjanskyi* Korovin), as a kind of spices, honey plants as fuel and building material in a primitive desert areas. In recent years, it turns out [3] and the possibility of their use as an ornamental, especially broad-leaved species (*Ferula kokanica* Regel & Schmalh., *F. foetidissima* Regel & Schmalh. Et al.), Recommended for landscaped *F. tenuisecta* Korovin, *F. penninervis* Regel & .. Schmalh, *F. ugamica* Korovin, etc., may have ornamental value and types: *F. dissecta* Ledeb, *F. karatavica* Regel & Schmalh, *F. kelleri* Koso-Pol... [4]. Application genus of *Ferula* a promising medicinal plants is based on the latest achievements of the content of biologically active substances in various organs with the greatest concentration of them in the roots, and especially the fruits. Therefore, the roots genus of *Ferula* and fruits are a real source of raw materials, and the usefulness of the fruit is defined as a high seed productivity, and in terms of preservation of the natural bush. In the Kyzylkum desert zone grow 10 species of the genus Ferula L .: *Ferula diversivittata* Regel & Schmalh., *F. schtschurowskiana* Regel & Schmalh., *F. foetida* (Bunge) Regel, *F. karelinii* Bunge, *F. litwinowiana* K.-Pol., *F . oopoda* (Boiss & Buhse) Boiss., *F. varia* (Schrenk) Trautv., *F. syreitschikowii* K.-Pol., *F. lehmannii* Boiss., *F. kyzylkumica* Korovin [5]. This work is devoted to the study of ontogeny of rare and endemic species - *Ferula kyzylkumica* Korovin.

Phylogenetic analysis of molecular data family of Apiaceae and phylogenetic arrangement of the genus of *Ferula* (Apiaceae), as well as seed germination, Morphological characteristics of seedlings, flowering periods, fruiting, biology, phenology, karpoanatomy, ecological anatomy, biology of flowering and cytoembryology, especially the localization of secretory receptacles in generative organs in desert species genus of *Ferula* L., as well as the tar content in the fruits of the three species genus of *Ferula* (*F. foetida*, *F. varia* and *F. kyzylkumica*) in a Southwestern Kyzylkum studied by many authors [6,15]. There is evidence of ontogenesis *Ferula songorica* [9] and some of the Pamir-Alai species genus of *Ferula* L. [15] and some information on the ontogenesis of *Ferula kyzylkumica* [13].

Kind of grows on stony and rocky slopes, on the outputs of variegated species on sanded gray-brown soils, on the remnant mountains Aral desert. The climate of the area is continental. The total solar radiation in the northern Turan desert is 130–140 kcal/cm^2 per year, and the radiation balance is 45–50 kcal/cm^2 per year. The total of temperatures above 10°C is 3600°C. The mean temperature is 10°C for January and 26–29°C for July. The growing period lasts 200–210 days (240–270 days in the southern Turan desert). The precipitation regime is similar to the Mediterranean type. The total precipitation is 100–150 mm per year. The snow cover in the northern part of the plateau is more stable [18]. The water and temperature regimes are characterized by the dryness index (2.5–6.0). The soil cover is formed by the combination of gray-brown soils that are solonchakous and solonetzic to varying degrees [19].

2. Materials and Methods

Genus of *Ferula* L. belongs to the tribe Peucedaneae Dumort. subfamily Apioideae Drude, family Apiaceae (Apiaceae Lindl.). Ferula - is a perennial herbaceous plant. Most of them are on the seasonal rhythm of development refers to a group ephemeroids and perennials with short

annual period of growth and development and a long rest period attributable to unfavorable time of the year. According to the features of a large passage of the life cycle of the genus of *Ferula* monocarpic and polycarpic. Monocarpic bloom once in the end of his life, and after fruiting they die completely. In policarpyc species of *Ferula* life cycle does not end after the first flowering and fruiting. The object of the research is *Ferula kyzylkumica* - rare endemic remnant low mountains and variegated Kyzylkum (Tamdytau, Beltau, Sangruntau, Bukantau, Kulzhuktau, Auminzatau), listed in the Red Book of the Republic of Uzbekistan [20]. Herbaceous perennials, polycarpic, ephemeroid (Fig.1). Stem solitary, up to 70 cm high, the base of the fibers enveloped dead basal leaves. Branches alternate. The record sheet in outline widely rhombic, trifoliate dissected. Stem leaves with strongly reduced plate, swollen vagina. Fruits are oblong-oval, pubescent few short hairs. Reproduction seed, blooms in May, fruiting in June. I eat all kinds of cattle.

Figure 1: General view of *Ferula kyzylkumica*

Field studies *Ferula kyzylkumica* carried on the territory of the relict mountains of Kyzylkum (mountain Kuldzhuktau and Auminzatau) in desert plant communities that are isolated hill on the plain area, elongated in the latitudinal direction. They are considered to be the western continuation of the mountain systems of Central Asia.

During research expeditions was found ceonotic population *Ferula kyzylkumica* and studied the ontogenesis of this species (Fig. 2). Relict mountain Kuldzhuktau length - 80 km, from north-east to south-west. The highest point - 789 m This figure is on the eastern part of 685 m, on the western part of the 466 m parallel Kuldzhuktau north of 25 km is located Auminzatau. Auminzatau length - 50 km. The highest point of East - 512, on its central part of this index is to 694 m, and the western - 646 m and the surrounding relict mountains Kuldzhuktau and Auminzatau captured sandstone Kyzylkum.

Studying the ontogeny of species was performed a conception of discrete description of ontogeny, first proposed by T.A. Rabotnov [21], further adjusted and elaborated by A.A. Uranov [22], [23] and his students [24], [25].

According to above mentioned sources, the plant life cycle is divided into four periods: latent, virginal, generative, senile. *The latent* age-state (primary dormancy state) represents an embryonic plant enclosed in seed; coenopopulation thus represents by seed bank in the soil. *The virginal* age-state is the period from germination to the beginning of generative breeding of individuals. Within a virginal period the plants can be distinguished by the following age-states: seedlings (young growth) *(p)* with mixed feeding (due to seed or cotyledons substances and assimilation of the first leaves); the presence of morphological connection with seed and/or the presence of cotyledons; the presence of embryonic structures as cotyledons, primary (embryonic) roots and shoots. *The juvenile (j)* age-state has unformed features of mature individuals, leaves with differ shape and location on shoots, other than those mature individuals; a differ type of shoots growth and branching, also the loss of connection with seed, the absence of cotyledons. A characteristic feature of the *immature (im)* age-state is the onset of branching: the transitional from juvenile to mature plants, in particular the form of the leaves, root system and shoots structure. *Virginile (v)* plants begin to show the main features for the typical mature individuals, but reproductive organs are still absent.

Generative age-state – the plants are characterized by the development of sexual organs and by the ability to form seed. Within this period the plants distinguished the following age-states: *young generative plants (g1),* formation of new parts. Prevailing new growth processes over death of old parts, demonstrated in various forms. It is the final formation of mature individuals. *Middle-age generative plants (g2)* show a relative equilibrium in the processes of formation and death of structures. They usually show the maximum yearly increase in biomass, the quantity of reproductive organs and maximum seed productivity. *Old generative plants (g3),* characterized by prevails of processes of parts death over the formation new ones, the generative activity is diminished, as is the rate of root and shoot formation.

Senile is age-state, when plants are not able to seed reproduction and doomed to death. *Senile plants (s)* characterized by accumulation of dead parts, and absence of viable buds.

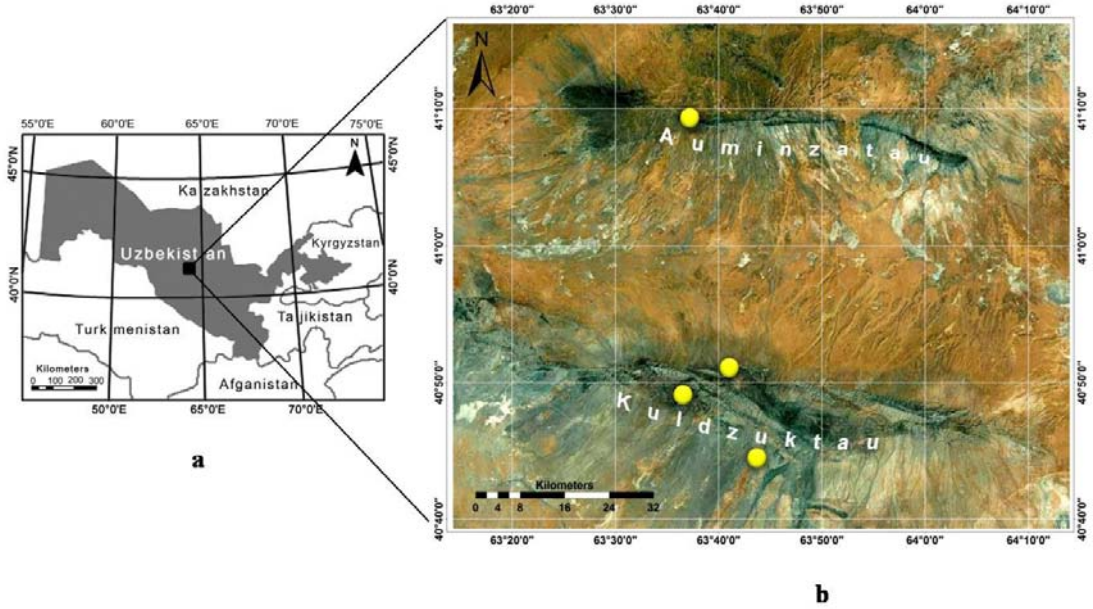

Figure 2: The area of study (a); the localization of coenopopulation of *Ferula kyzylkumica* in Kuldzhuktau and Auminzatau mountains (b).

Brief description of eco-pytoceonotic surveyed ceonopopulation given in the Table-1.

First ceonotic population studied in the south-eastern part of the ridge Kuldzhuktau (with granite outputs) at an altitude of 505 m above sea level (N40.813850 E063.605410). Soil - gravelly. It grows as a part of the forb-wormwood community. The community is dominated by *Artemisia diffusa* Krasch. ex Poljakov and *Salsola arbuscula* Pall. Total projective cover of grass is 10%. The species composition of the community amounted to 23 species, including shrubs and shrubs on - 1, perennials - 14 and annuals - 7. The second ceonotic population described on the southern spur of Kuldzhuktau (varuegated) at an altitude of 366 m above sea level (N 40.732030E 063.731810). The vegetation is dominated by *Artemisia diffusa* Krasch. ex Poljakov. Total projective cover of grass 6%. The plant grouping consists of 16 species, of which the bush - 1, shrubs - 2, shrubs and shrubs 1, perennials - and annuals 6 - 5. Next cenopopulation big stone studied on the slopes of the central part of Auminzatau at an altitude of 612 meters asl (N 41.156970E 063.622810). The dominant community is *Artemisia diffusa* Krasch. ex Poljakov and *Salsola arbuscu*la Pall. Total projective cover of grass is 8%. The species composition of the community consists of only 9 species, including shrubs - 2 shrubs - 1, perennials - 3 annuals - 3. The fourth ceonopopulation allocated Kuldzhuktau on stony slopes at an altitude of 679 meters asl (N 40.504740E 063.404500). Total projective cover of grass is only 3%. The species composition of the community is composed of 19 species, including trees and shrubs 1, perennials - 10 and annuals - 7.

Table 1: Characteristics of the studied ceonopopulations (CP) *Ferula kyzylkumica* the relict mountains of East Kyzylkum

№ CP	Geographical location of coenopopulation	Geographical coordination	Altitude, m	Plant community	Total projective cover of vegetation, %	Projective cover of species, %
1	The south eastern part of Kuldzhuktau (with granite outputs)	N 40.81385^0 E 063.60541^0	505	*Artemisia diffusa, Salsola arbuscula, Scorzonera gageoides, Poa bulbosa, Ferula kyzylkumica*	10	1
2	Southern spurs Kuldzhuktau	N 40.73203^0 E 063.73181^0	366	Herbal grouping involving *Ferula kyzylkumica*	6	1
3	Central part Auminzatau	N 41.15697^0 E 063.62281^0	612	*Salsola arbuscula, Artemisia diffusa*	8	1
4	Kuldzhuktau (around Shaydaras – well region)	N 40.50474^0 E 063.40450^0	679	*Salsola arbuscula, Stipa aktauensis, Ferula kyzylkumica, Poa bulbosa*	3	1

3. Results and Discussion

The ontogeny - the development of an organism in specific environmental conditions, during which there are regular changes in the body. In accordance with these changes, the ontogeny of the plant is divided into stages and periods. In ontogenesis *Ferula kyzylkumica* allocated 3 periods and age 7 states: in the virginal period - Juvenile (j), immature (im), virginal (v) the state; in generative period - young generative (g1), middle-generative (g2), aging (g3) generative; in senile period (s) age-related condition (Fig. 3).

At the time of the study individuals seedlings age condition we were not detected. According AA Butnik et al. [13], the seedlings have *Ferula kyzylkumica* overhead, hypocotyl. In early March, the cotyledons narrowly linear, base their fused into a long tube cotyledon. In the middle of this month there is the first simple, oblong-triangular, pinnate, with large

serrated leaf lobes. By the end of April and 2 sheets formed cotyledons wither.

Juvenile plant has 1-5 leaf length and width 2.5-3 0.6-1 cm. The root system is taprod. The main root deep into the soil up to 8 cm, tuberous thickening was observed. There is one root side length of 4 cm. The duration of this state lasts for up to 5 years.

In the immature state of the plant age go for 4-6 year vegetation. At this time, the increase in size of bodies; thicken the tuber and the main root. The plant has 5 leaves. Record sheet two - pinnately dissected, 9-18 cm long, 4-12 cm wide. It has from 4 to 7 fractions. At this time, it begins to form caudex (1.5-2 x 1-1.5 cm). Some specimens of plants in the main root of the observed 1-2 tuberous bulges. This biological adaptation plants, as long root grows slowly because of the small amount of moisture in the soil during the dry season. Tuberous thickening spherical or plum shape, the size of 1.0-2.0 x 0.7-1.5 cm. The main root deep into the soil up to 15 cm, 0.7-1 cm in diameter. Often formed lateral root length up to 4, 5 cm. The duration of this state lasts up to 3 years.

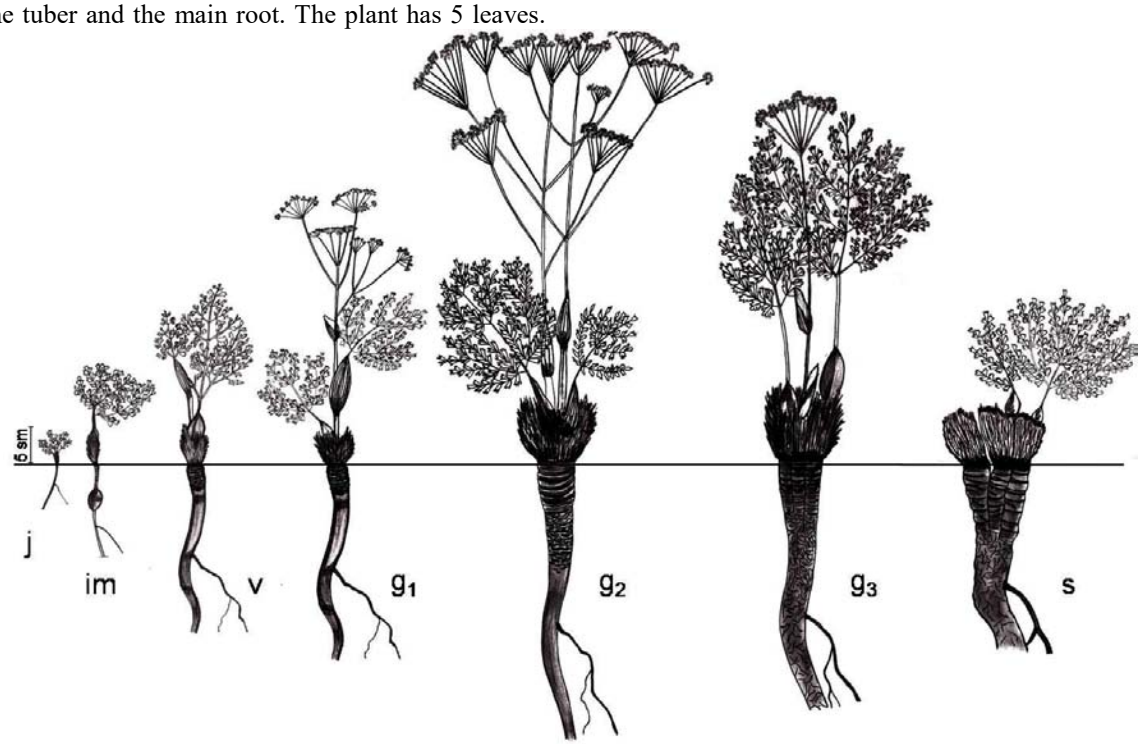

Figure 3: The ontogeny of Ferula kyzylkumica: j - juvenile, im - immature, v - virginal, g1 - young generative, g2 - middle-generative, g3 - aging generative, s - senile state.

The virginal state age plants have all the morphological features inherent in adult individuals, but does not bloom and bear fruit. Plant height increased to 28 cm. The main root thickens up to 1-3 cm, tuberous thickening smoothed. Caudex up to 3-4 cm. The leaves are leathery, which is typical for *Ferula* with a longer growing cycle [2]. The number of rosette leaves reaches 6. Leaf length increases from 10 to 20 cm, width 6-15 cm. Record it becomes repeatedly dissected. On one sheet of plate 4-10 has a share. The penetration of the root system in the soil moderately deep - up to 23 cm. The duration of this state lasts from 7 to 15 years or more.

Generative period. In this period were described: young (g1), middle-aged (g2), aging (g3) generative state.

Young generative state. The transition to the generative state of nature in polycarpic observed in the 6th year [11]. And in a culture (Tashkent) *Ferula kyzylkumica* enters the generative period of 3 years [13]. The plant forms a generative shoot, caudex up to 3.5-4 cm long, 1.5-2 cm thick. The main root at this stage is well defined and to a depth of 10-20 cm is uniformly thickened, up to 70 cm.. In the aerial part of young individuals constitute 3-4 leaves 10-20 cm long, 5-16 cm wide Inflorescence - Cyme. The number of flowers in an umbel 8-12 pcs., Peduncle length of 5-11 cm. The plant has 2 to 8 umbel and forms 40-60 pcs. fruits. In the year of entry into the plant in the state of generative vagina 2-4 x swollen stem leaves, 2-5 cm long, tightly cover the inflorescence axis. The duration of this state lasts from about 8 to 18 years or more (Fig.3).

Middle-generative state. In the year of surveillance specimens of this age dominated by the state than younger individuals generative. Plants have reached the maximum development and were more powerful. Plant height reached 60-70 cm, a single inflorescence has 10 to 16 umbel. The number of flowers in an umbel of 10-14, 8-12 cm long stalks. Caudex 4-5 cm long and 2-3 cm thick. The main root from the bottom to a depth of 25-30 cm is thickened. There are 2-4 green leaf sheaths. Formed 3-6 leaf length 11-19 cm, a width of 7-14 cm. During the flowering 1-2 generative form of escape. Thus, in this stage, the middle-generative significant increase in the size of all parts of the plant. The duration of this state lasts from 15 to 28 years or more.

Aging generative state. Plant height up to 66 cm. The aging in a special way from 4 to 7, and leaves only one generative shoot. Well it formed its main structural part-partikuly (2-3).The main root is thickened up to 3 cm Individuals have a

strong caudex 4-6 cm long, 3-4 cm thick number of rays of umbel - 6-8, and the number of flowers in an umbel - 6-10 pieces. The duration of this state lasts from 26 to 36 years or more.

In the senile period, increase the size of the underground parts of the plant - the thickness of the caudex (7-8 cm). Outlines the first outward signs of particulation caudex it occurs death of individual partikul. Generative shoots are formed. The duration of this period lasts from 30-35 years or more.

4. Conclusion

In the context of the Kyzylkum desert *Ferula kyzylkumica* long life cycle consists of several age-related conditions. Indicator states are signs of age: for juveniles availability - 1-5 leaf, lateral root formation; for immature birds - forming caudex and tuberous thickening at the root; for virginal - possessing all the morphological characteristics of an adult individuals; Young generative individuals - the formation of generative shoot; for middle-generative individuals - the prevalence and high development, generative than younger individuals; for older generative individuals - the formation of partikul and having strong caudex; for senile - death of individual partikul not form generative shoots.

Thus, in the Kyzylkum desert *Ferula kyzylkumica* long away life cycle consists of several age-related conditions. The total duration of *Ferula kyzylkumica* life, depending on the place of growth according to our data is more than 35 years. This is the result of long-term adaptation to the climatic peculiarities of Kyzylkum desert. It must be borne in mind that the selected age groups are relative, since different individuals can pass the planned state age at different rates. In nature, there are all sorts of violations under the influence of anthropogenic factors.

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