Growth and development of *Ferula foetida* Regel (Bunge) and *Ferula tadshikorum* Pimenov species in different environments

Mokhira Halkuzieva[1,*], *Xurshid* Qiryigitov[2], *Bekzod* Abduazizov[2], *Mukaddas* Sobirova[1] and *Bakhora* Usmonova[2]

[1]Jizzakh Branch of National University of Uzbekistan, Jizzakh, 130100, Uzbekistan
[2]Jizzakh Polytechnic Institute, Jizzakh, 130100, Uzbekistan

Abstract. The daily increasing demand for medicinal products obtained from *Ferula foetida* (Bunge) Regel and *F. tadshikorum* Pimenov, from species of the *Ferula* L. family, is causing a decrease in plant biodiversity and their reserves. This paper presents the growth and development of *F. tadshikorum* and *F. foetida* in different environments under plantation conditions. The seeds of *Ferula foetida* (Bunge) Regel and *F. tadshikorum* Pimenov were sown separately in sandy, gray and potash-rich soils, 0.5-1.0 cm deep, in 2 variants in December. The second control option - germination biology and growth of morphobiological characteristics of lawns under waterlogging was studied The amount of potassium in the soil in the experimental areas of Dekhkanabad district of Kashkadarya region was 1,910%, 1,210% in Arnasoy district and 1,220% in Sharof Rashidov district. It was found that the germination growth and development level and vegetation of *F. tadshikorum* and *F. foetida* seeds were much higher in the soils of the experimental fields of Dekhkanabad district of Kashkadarya region in both options. When plantations are established by planting *F. tadshikorum* and *F. foetida* from seeds, adding potash fertilizers to the soil will allow them to grow well.

Keywords. Stem, seed, plant, F. tadshikorum, F. foetida, plantation, natural.

1 Introduction

Scientific research is being conducted in the world to determine the reasons for the decline of medicinal plant species as a result of the influence of natural and anthropogenic factors, to improve the ways of their preservation and reproduction [1-3]. Especially from medicinal plants *Apiaceae* Lindl. The growing demand for medicinal products from *Ferula foetida* (Bunge) Regel and *F. tadshikorum* Pimenov, belonging to the genus *Ferula* L., is causing a decrease in plant biodiversity and reserves. In addition, their low potential for natural reproduction, the influence of anthropogenic factors and their location in pressure areas, climate change have a negative effect on their regeneration [4-6]. Particular attention is paid to determining the growth and development of *F. foetida* and *F. tadshikorum* species

* Corresponding author: asatullayevnamohira@gmail.com

in different conditions, planting and breeding from seeds in dry conditions of hill and desert regions, establishing plantations and creating quality raw materials [7].

Systematics, carpology, ecology and distribution of some species of the *Ferula* L. genus [8-11], and reflected in the work of others [12-14]. The anatomical structure of the fruit of some species of the genus *Ferula* L. (*Apiaceae* Lindl.) was analyzed [15-18].

In Uzbekistan, biology and stocks of *Ferula* L. species studied by U. Rahmonkulov, Kh. Nishanbaeva, Kh. Rakhmonov, anatomy, cytoembryology by A.A. Butnik et al., chemical and pharmacological properties A.I. Saidkhodzhaev, G.K. Nikonov [19-25].

The beginning of vegetation of monocarpic plant *F. tadshikorum* began in February, end of March, and their life cycle lasts long 23-27. The lawn stage includes 1 year of vegetation, the juvenile stage is 6-7 years old, 14-15 years old, and the immature age is 24-27 years old (10) [26].

Hence, 1-3% immature condition (05.06.2019) was observed in the first year of *F. tadshikorum* plant. In the third year (2022) in both variants, 70-75% (18.02.2021) plants were immature [27-29].

2 Materials and methods

F. tadshikorum and *F. foetida* are perennial herbaceous, monocarpic, hemiephemeroid plants. In Uzbekistan, *F. tadshikorum* is found mainly in the mountainous regions of Kashkadarya and Surkhandarya regions, *F. foetida* is found in different groups of plants in deserts and hills, and is distributed in the Kyzylkum deserts, Mirzachol, Karnabchol, Samarkand, Jizzakh, Bukhara, Kashkadarya, Surkhondarya regions and the territories of the Republic of Karakalpakstan.

The seeds of *F. foetida* plant are stringy on the outside, wing-like on the edges, the size and absolute weight of the seeds varies depending on the place of growth of the plant. The largest seed was collected from the southern slope of the Nurota ridge, its length was 2.4 cm, width 1.6 cm, thickness 0.7 mm, and the absolute weight of 1000 seeds was 60.3 grams.

The seeds of *F. tadshikorum* are 1.5-2.0 cm long, 0.8-1.0 cm wide, elliptical or leaf-shaped, hairless. The absolute weight of the seed is slightly smaller than that of *F. foetida*, 35 - 40 gr. Their seeds need to pass a period of low temperature and rest for normal germination [30-32].

In 2014-2021, in the Arnasoy district of Jizzakh region, on the territory of the "Shifo kovrak" farm, *F. foetida* and *F. tadshikorum* were planted from seeds and plantations were established on an area of 20 hectares. Arnasoy district consists of plains and low plains, the soils are sandy and gray, potassium rich, and there are partial salt marshes in the northeastern part. The climate is strictly continental.

3 Results and discussion

When creating plantations from medicinal plants, the quality of the seeds sown, the degree of germination when the seeds are planted at different depths are important. Below are the results of the germination rate of the seeds of both carpet species when planted at different depths.

It is known that during the germination of the seeds, its cotyledon leaves have the (epigial) feature of raising the seed coat to the surface of the earth. Our observation showed that the longer the seeds are, the deeper the seeds can lift the seed coat above the ground. For example, if the seed of *F. tadshikorum* is up to 2 cm long, its seeds will germinate from

the soil up to this depth, the germination of seeds that fall into the soil deeper than that is very small. A seed planted deeper than that will not have the strength to lift its skin.

According to O. Khojimatov, the average fertility when planted at a depth of 0.3-0.5 cm is 57 %, after 4 years there are an average of 420 (42 %) plants in the field, when planted in the surface layer of the soil, the fertility is 50 %, after 3 years it is 22 % the plant is preserved. In tall lawns (option No. 3), good viability rates of 21-24 % were determined even when planted in the surface layer of the soil [12].

In order to determine the degree of germination of *F. foetida* and *F. tadshikorum* at different depths and in autumn and winter months, the seeds of *F. foetida* were collected from Surhondarya region, and the seeds of *F. tadshikorum* were collected from Dekhkanabad forestry of Kashkadarya region in summer and cleaned and sorted. Experimental work was carried out in laboratory conditions and in the territory of the farm "Shifo-kovrak" in Arnasoy district, Jizzakh region, and in experimental fields in Sharof Rashidov district during the years 2018-2020. The areas allocated for planting seeds were well plowed and fertilized to a depth of 35.0-40.0 cm, and if there were uneven areas, they were leveled with tar.

100 seeds were sown separately in soils rich in sandy, gray and potash fertilizers, at a depth of 0.5-1.0 cm in December in 2 variants, the first control variant - Seeds were grown in outdoor natural conditions (Figure 1). The second control option - germination biology and the growth of morphobiological properties of lawns during waterlogging was studied [25].

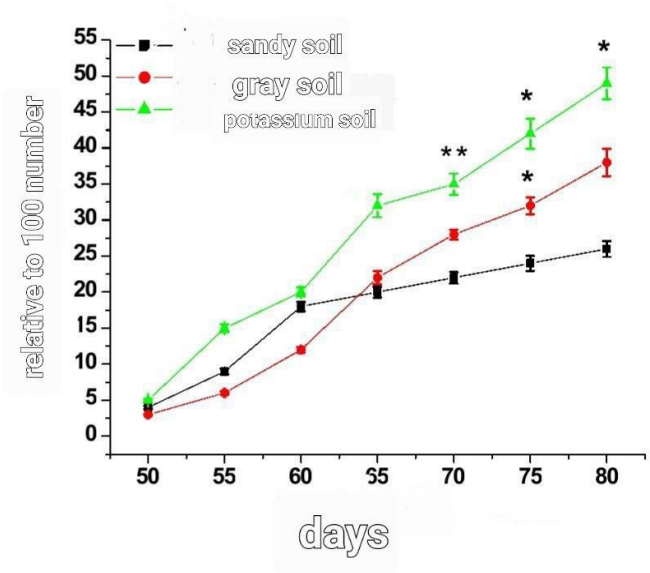

Figure 1. Germination of *F. foetida* in different soils in natural environment (n=100).

From Figure 1, it is known that the germination of *F. tadshikorum* seeds in potassium-rich soil was much higher (48 %) than in other soils, and the lowest germination (20 %) was observed in sandy soil.

Figure 2 shows the germination rate of seeds in potassium rich and organic fertilizer was higher (56%) when collected in watered medium, while seeds planted in sandy soil gave the lowest rate (26%).

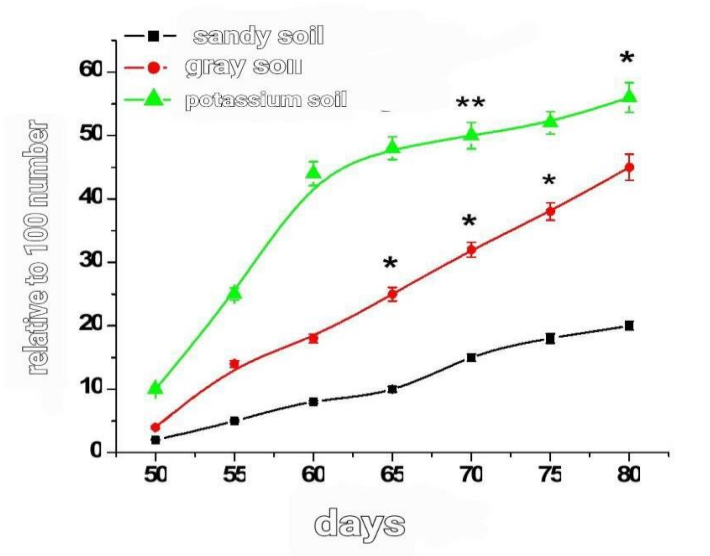

Figure 2. Germination of *F. foetida* in different soils wetted with water (n=100).

After planting *F. foetida* in a natural and watered environment (01.02-25-04.2020), the majority of seeds germinated within 90 days. The cotyledons are long lanceolate, light green in color, germinated in 65 days in natural environment and dried in 105 days. In the water-fed environment, seeded leaves were formed in 55 days and started to dry out in 115 days.

The shape of the first leaf is ovate, oblong, with a flat edge, and this type also produces 2 or 3 leaves. In the control variant, first leaves were produced in 85 days and withered in 130 days. However, true leaves were preserved for up to 145 days in potassium-rich soil. In the experimental version, the seed leaves were formed in 72 days and began to dry in 145 days (Table 1).

Table 1. Morphological classification of cotyledon and true leaf of *F. foetida* in natural environment on different soils (n=100).

Seed leaf		**First leaf**		
Length cm	**Width, mm**	**Length cm**	**Width mm**	**Length cm**
Sandy soil				
2.5±0.11	0.15±0.01	3.5±0.17	0.7±0.03	1.45±0.07
Soil rich in potassium				
4.0±0.20	0.3±0.02	5.5±0.27	1.0±0.05	2.0±0.10
Gray soil				
3.0±0.15	0.25±0.11	4.0±0.20	0.8±0.04	1.5±0.07

From Table 1, it is known that *F. tadshikorum* had high growth of grasses in potassium rich and gray soil, but its development was slow compared to them in sandy soil. From Table 2, it can be seen that the growth rate of grasses rich in potassium and grown in organic fertilizer when collected in watered environment was much higher, while the growth rate of grasses in sandy soil was the lowest.

Table 2. Morphological classification of cotyledon and first leaf of *F. foetida* in natural environment in different soils.

Seed leaf		**First leaf**		
Length cm	**Width, mm**	**Length cm**	**Width mm**	**Length cm**
Sandy soil				
3.5±0.17	0.25±0.01	5.5±0.22	1.1±0.05	2.25±0.09
Soil rich in potassium				
5.5±0.27	0.45±0.02	10.0±0.43	1.5±0.07	4.0±0.16
Gray soil				
3.5±0.16	0.45±0.03	6.5±0.32	2.5±0.11	2.5±0.12

When *F. foetida* was planted in a natural and water-fed environment, grass growth was high and vegetation lasted longer. Germination and development of *F. foetida* seeds were found to be significantly higher in potash soils in both variants. When planting *F. foetida* from seeds, it is recommended to apply potassium fertilizers to the soil. Germination of seeds of *F. tadshikorum* under different soil conditions.

In order to determine the fertility of *F. tadshikorum* in soils of different composition, under natural and moisture-preserved conditions, seeds collected in August 2019 in the forestry area of Kashkadarya region were used (Figure 3).

Seeds were sown separately in sandy, gray and potash-rich soil in 100 seeds at a depth of 0.5-1.0 cm in December in 2 variants. The second control option - germination biology and the growth of morphobiological features of lawns when wetted with water was studied.

Figure 3. Germination of F. tadshikorum in different soils in natural environment.

The shape of the green leaf is rhombic, the leaf plate is oblong, the edge is finely cut. In the control variant, the green leaves were formed in 80 days and dried in 130 days. However, true leaves survived up to 150 days in potassium-rich soil. In the experimental version, the cotyledons were formed in 70 days and started to dry in 150 days.

From Table 3, it is known that the growth of *F. tadshikorum* lawns in potassium-rich and gray soil is high, and their development is relatively slow in sandy soil.

Table 3. Morphological classification of cotyledons and cotyledons of *F. tadshikorum* grown in natural environment on different soils (n=100).

Soils	Seed leaf		First leaf		
	Length cm	Width mm	Length cm	Width mm	Length cm
Sandy soil	2.5±0.12	0.15±0.01	3.5±0.17	0.7±0.03	1.45±0.07
Soil rich in potassium	8.0±0.40	0.3±0.01	5.5±0.27	1.0±0.05	2.0±0.10
Gray soil	3.0±0.15	0.25±0.01	4.0±0.20	0.8±0.04	1.5±0.07

When collected in a watered environment, grasses rich in potassium and grown in organic fertilizer had a much higher growth rate, while grasses in sandy soil had the lowest growth rate (Table 4).

Table 4. Morphological classification of cotyledon and cotyledon of *F. tadshikorum* in water-moistened environment on different soils (n=100).

Soils	Seed leaf		First leaf		
	Length cm	Width mm	Length cm	Width mm	Length cm
Sandy soil	2.5±0.12	0.15±0.01	3.5±0.02	0.7±0.03	1.45±0.07
Soil rich in potassium	4.0±0.18	0.3±0.01	5.5±0.27	1.0±0.05	2.0±0.10
Gray soil	3.0±0.14	0.25±0.01	4.0±0.20	0.8±0.04	1.5±0.07

4 Conclusions

The amount of potassium in the soil in the experimental areas of Dekhkanabad district of Kashkadarya region was 1,910%, 1,210% in Arnasoy district and 1,220% in Sharof Rashidov district. It was found that the germination growth and development level and vegetation of *F. tadshikorum* and *F. foetida* seeds were much higher in the soils of the experimental fields of Dekhkanabad district of Kashkadarya region in both options. When plantations are established by planting *F. tadshikorum* and *F. foetida* from seeds, adding potash fertilizers to the soil will allow them to grow well.

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