

Biodiversity and *Ferula gummosa*

Subjects: **Plant Sciences**

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Ferula gummosa (FG) is named Barijeh, Balijeh, Ghasni and Barzard in Persian. It belongs to the *Ferula* genus in the family Apiaceae. This family with at least 112 genera contains aromatic plants with hollow stems and umbrella inflorescences. The genus *Ferula* contains 170 species and is extensively distributed from Central Asia to South Africa. FG is one of the industrial, medicinal and forage valuable assets in Iran. As a dominant or associated species, it forms a wide range of plant types in mountainous areas. The phenological stages of the FG plant are as follows: seed germination starts from late March to early April, and vegetative growth begins from the second half of April and continues until the first half of July.

Ferula gummosa

eco-distribution

rangeland

ecology

Zanjan

1. Overview

The uncontrolled exploitation of soil and plants by people has generated important ecological imbalances all over the world. This manuscript focuses its attention on the ecosystem of *Ferula gummosa* (FG). FG belongs to the Apiaceae family and has a vast distribution from central Asia to South Africa, as well as northwest Iran, including the Zanjan Province. This plant has diverse applications across industrial, forage and medicinal fields. To investigate the effective factors on the FG distribution, four main natural habitats were selected based on field visits and a literature review. Then, environmental factors, such as climate features, topography conditions, and soil characteristics, were collected and analysed. According to the results, the slope is mainly north-northeast with a slope of 55 to 70 degrees, and an elevation range above 2200 m is suitable for the growth of FG in the Zanjan Province. The main companion plants were *Silene bupleuroides* L. and *Thymus kotschyanus*. The results show that in the habitats where FG grew, the soil was mostly shallow, sometimes semi-deep and consisting mainly of loam, loamy sand, loamy clay and mostly clay loam with very low salinity (less than 0.7 dS/m), and was in the neutral range of soil acidity (6.9 to 7.33). Soil organic carbon was relatively high, but the amount of nutrients, such as phosphorus and potassium, was less than optimal in these soils. Next, using a Geographic Information System (GIS), maps of homogeneous areas for possible FG establishment across the province were created. In conclusion, the main factors affecting the FG distribution in the Zanjan Province were land use conversion, harvesting fodder and grazing livestock, improper exploitation of rangelands, pests and diseases of *Ferula gummosa* in the region. The ecological data collected on FG may be useful to understand how human action can affect the existence and extinction of many plant species.

2. *Ferula Gummosa*

Ferula gummosa (FG) is named Barijeh, Baliجه, Ghasni and Barzard in Persian [1][2]. It belongs to the *Ferula* genus in the family Apiaceae. This family with at least 112 genera contains aromatic plants with hollow stems and umbrella inflorescences [3]. The genus *Ferula* contains 170 species and is extensively distributed from Central Asia to South Africa [4]. FG is one of the industrial, medicinal and forage valuable assets in Iran. As a dominant or associated species, it forms a wide range of plant types in mountainous areas [5]. The phenological stages of the FG plant are as follows: seed germination starts from late March to early April, and vegetative growth begins from the second half of April and continues until the first half of July. According to the monocarpic nature of FG, its phenology continues in two ways: plants that go through the prematurity stage have only basal leaves, and from mid to late June, their vegetative growth stops, and the leaves begin to dry out. These leaves are easily separated from the roots by the wind. However, the roots remain in the soil and grow again the following year. In plants that are in the last year of their life, flowering begins from the middle to the end of May. The sowing date is from the end of June to the middle of July and the ripening of the seeds happens at the end of July. November and December are the best times to plant FG seeds. The seeds of this plant begin to germinate and grow at 3 to 5 °C. In order to break the dormancy period of the seed and its stratification, it needs to pass a cold period between 3 to -15 °C for 15 to 45 days.

FG shows important applications in cosmetics, pharmaceuticals and animal breeding [6]. In particular, the cosmetic industry requires increasingly greater quantities of FG for its perfume [7]. Indeed, the resin is used for incense, and, above all, as a base for many known fragrances [8]. In the pharmaceutical field, FG-based products are considered energizers, mucolytics and pain relievers for the stomach and joints. The resin of FG is used as a cosmetic in skin care creams. In addition, other authors report an anti-parasitic effect for humans and farmed animals [6]. Finally, in the zootechnical field, some varieties of FG are dried and used to enrich the food of farm animals with nutrients. Some anecdotal observations on livestock report warming effects and an increase in fertility [9]. Like other plant species that are exploited for their therapeutic potential [10][11][12][13][14], FG is among the main plants exploited for its resin [6][15].

Environmental factors such as climate features, topography conditions and soil characteristics affect the establishment of habitats in any region considerably [16]. The distribution of plant species in rangeland ecosystems is not accidental; rather, environmental factors such as climate, soil, topography and human activities play an important role in the expansion of plants [17][18]. Some authors have shown that the establishment of plant communities in mountainous areas is mainly affected by climate factors, and in low-lying areas and rolling hills by soil factors [19][20][21][22][23]. Therefore, it seems that regarding the establishment of FG in the highlands, climatic factors have the greatest role in the distribution and establishment of this plant. This plant is highly resistant to severe cold and frost in mainly semi-arid areas, and it usually grows well in cold and ultra-cold Mediterranean regions with an average annual temperature between 3.5 and 12 °C, the minimum absolute temperature being less than -30 °C and the maximum absolute temperature 40 °C. Areas with an average annual rainfall of 300–450 mm, in which most of the precipitation is snow, are suitable for this plant. Shallow soils, sometimes semi-deep, medium to heavy texture (loam, loamy sand, loamy clay and mostly clay loam), calcareous, sometimes up to about 30% lime and without salinity and alkalinity, are desirable for this plant [24].

Despite these considerable applications, even today it is difficult to cultivate *FG* due to its particular conditions of growth and development [25]. Furthermore, the lesions induced on the surface of the stem of *FG* to produce the resin are deep and often lead to the death of the plant [26]. Therefore, the growing demand of the cosmetic and pharmaceutical industry for these species and the alterations of natural habitats, as reported by many authors [6], could lead to its extinction in the wild.

3. Conclusions

The results collected in this study on the ecology of *FG* have shown how the different ecosystems in which this species lives show physical-chemical characteristics suitable for the growth and spread of *FG*. At the same time, anthropic activities have a destructive effect on the ecological niches of *FG*. In particular, the indiscriminate exploitation of land aimed at grazing livestock reduces biodiversity and alters the habitat of *FG*. Population growth and the consequent increase in the human need for food is considered in many parts of the world to cause the disappearance of many wild plant and animal species [11]. Farmers and ranchers exploit poor and marginal lands, which mainly have a high erosion potential and a low production potential [27]. The soil of these areas has a natural yield and a specific organic matter for the endemic plant populations that live there. The indiscriminate exploitation of these soils reduces biodiversity and disrupts the balance of ecosystems, with a great impact on organic matter and other physical, chemical and biological properties of the land, leading to soil desertification. This anthropic action on the environment has also affected the habitats of the *FG*. Lack of attention in pruning, indiscriminate use as forage and the disappearance of plant biodiversity could lead to the reduction in and subsequent extinction of *FG*. This important problem observed for *FG* can be observed in many other plant species living in other ecological niches.

In conclusion, many plant species are at risk of extinction in the world due to mankind's improper lifestyle. *FG* has shown many adaptive capacities to different ecosystems and to attacks by insects. However, the excessive exploitation of the plant and the soil could reduce the spread of *FG* and lead it to extinction. Only greater awareness and sustainability of human societies towards the environment will be able to preserve biodiversity while avoiding the extinction of many plant species such as *FG*.

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