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Research and Full Length Article:

Effect of Topography and Soil Properties on Distribution of *Ferula pseudalliacea* (Bitter Asafetida) in Yazd Province, Iran

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Abstract. *Ferula pseudalliacea* (Bitter asafetida) is an endemic medicinal plant grown in the center of Iran, which is used in pharmaceutical industries. There is less report about its habitat characteristics and distribution in Iran. So, this research was conducted to study the effects of topography and soil properties on distribution of this species in Yazd Province, Iran in 2016 and 2017. Two habitats (Chenarnaz and Borooieh) were selected and data were collected for vegetation cover and soil parameter using random systematic methods. All data were analyzed in SPSS software. The results indicated that this plant often grows in mountainous regions with calcareous formation. Its phenological activities are extremely under the effect of climate conditions. This species grows in all aspects and slopes higher than 25%. In Chenarnaz, the highest canopy covers was in north aspect (3.13%) and the lowest canopy covers was obtained in south aspect (1.65%). Similarly, the highest amount of canopy covers was observed in north aspect (2.55%) and the lowest one was in south aspect (1.65%) in Borooieh. 2400-2500 m altitude had the highest amount in two habitats, So that the amounts were obtained in Chenarnaz 3.42% and in Borooieh 2.55%. There were significant differences for many parameters between two habitats. The higher mean values of canopy cover percent, density, plant area, collar diameter, thousand seed weight and soil parameter as saturated moisture, silt, pH and organic matter were obtained in Chenarnaz and the highest sand percent and EC were obtained in Borooieh habitat. The results showed that this species grows in soils with lime amount between 55.92% to 58.27% and sandy loam texture, acidity of 8.09 to 8.23 and organic matters of 1.20% to 1.97%. The results of this study can be noticed for proper range management, conservation and development of this valuable species in such conditions.

Key words: Bitter Asafetida, Canopy cover, Ecological conditions, Soil texture

Introduction

Plants play an important role in organism's lives, nature conservation and ecosystem sustainability (Sharifi Yazdi *et al.*, 2009). Recognition and introduction of endemic plants, especially medicinal and industrial ones are so important for their utilization (Azhir & Shahmoradi, 2007; Jahantab *et al*., 2011a). Medicinal plants produce raw materials for different industries, so they are important in economic development, pharmaceutical and food security (Toupchi, 2011). Preservation of endemic plant species in their natural habitats and identification of their ecological conditions are in high priority (Safaeian *et al.*, 2007; Sharifi Yazdi *et al.*, 2009; Ebrahimian *et al.*, 2013). *Ferula genus* belongs to Umbeliferae family composing170 species which most of them are medicinal and industrial (Eskandari Damaneh & Sharafatmandrad, 2017). They are extensively distributed in Mediterranean region and central Asia. More than 30 species are native to Iran (Mozaffarian, 1983; Amiri & Jouharchi, 2016). *Ferula pseudalliacea* (bitter asafetida) is a well-known industrial and medicinal perennial herb, producing gum. Its latex has lots of resin and essential oil compounds (3-7% essential oil, 62% resin and 25% gum) (Pirmoradi, 2012). The most important pharmacological effects of *F. asafetida* are digestive diseases treatment, anti-oxidant and anti-tumor properties (Kavoosi & Rowshan, 2013).

Ferula pseudalliacea grows up to 230 cm. Their Basal diameter ranges from 6 to 8 cm. It is monocarpic and has leaves with short hair, compound umbels, yellow flowers and schizocarp fruits. Length of calycles is 1.5 mm. The number of male umbels is eight with long pedicels. Central umbels are fruitful with short pedicels and without hair. The leaves lobes are linear-bayonet and rectangular. Lower leaves are three times duplex. The leaves have 37-48 cm length and 20-33 cm width. Roots are relatively thick, straight and succulent. The root length is 30-40 cm. Its latex (gum oleoresin) is extracted from their rhizome or tap root (Mozaffarian, 2007; Dastan, 2011). *Ferula pseudalliacea* gum has resin and essential oil compounds (3-7% essential oil, 62% resin and 25% gum) (Pirmoradi, 2012). Asafetida gum which is obtained from different species of Ferula is widely used in pharmacology and other industries. The most important pharmacological effects are digestive and nervous disease treatments, anti-fungal, antioxidant activities and anti-tumor (Dehpoor *et al*., 2009; Kavoosi and Rowshan, 2013). There are several studies about Apiaceae family plants and their ecological conditions. Azhir and Shahmoradi (2007) studied autecology of *Ferula ovina* in Tehran province. Their results showed that habitat elevation for this species is 2000-3200 m above sea level. They found that this plant prefers loamy and sandy loam soils. Sharifi Yazdi *et al.* (2009) investigated autecology of *Ferula oopoda* in Kerman province. They showed that this plant grows in northern aspects with elevations of 2000-3100 m, shallow soil depth and coarse texture. Jahantab *et al.* (2011a) introduced *Kelussia odoratissima* medicinal species in central Zagros in Kohgiluyeh region. They declared that this plant grows in different slopes and in low to half depth soils with medium texture. This plant habitat was in altitude ranged from 2450 to 3000 m. In another study, they investigated autecology of *Ferulago angulata* in this region and found that this species grows in loamy and sandy loam soils with acidity of 7.5 and slopes of higher than 40-45%. Its growth stage was four months (Jahantab *et al.*, 2011b). Pirmoradi (2012) showed that *Ferula assa-foetida* grows in light texture soils with low organic matters. He found that growth stages delayed with increasing elevation in rangelands of Kerman. Ebrahimian *et al.* (2013) studied ecological and phenology characteristics

of *Ferulago angulata* and declared that canopy cover of this species ranges from 6.1% to 15.7% in its habitats in Kerman province, Iran. They found that it grows in soils with acidity of 7.5-7.8 and 2750-3540m elevations. Hosseini Bamroud and Mahdavi (2013) investigated ecological characteristics of *Ferula assa-foetida* in Khorasan province. They realized that soils in the habitat of this plant are calcareous (15-17%) with acidity of 7.5-8. This plant had higher density in Northern slopes. Phenology stages of this plant lasted four months. Moghaddam and Farhadi (2015) found a positive correlation between resin yield and precipitation rate. They found a progressive increase with decreasing altitude and precipitation rate. Aghajanlou and Ghorbani (2015) showed that aspect, pH and percentages of sand, moisture and clay are the most effective factors in separating *Ferula ovina* and *Ferula gummosa* habitats in Zanjan habitats. Mahmoudi *et al.* (2015) studied the effect of topography on *Ferula gummosa* distribution in rangelands of Khorasan and concluded that elevation and aspect that are effective in temperature and moisture are the main factors to control *Ferula gummosa* distribution. Jafari *et al.* (2017) found the same results about *Ferula gummosa* distribution in North West of Iran rangelands. The only research about *Ferula pseudalliacea* was done in Kurdistan province, Iran. During this research, it was determined that premature seed has the most essential oil percent. The main compounds in different stages were Bulnesol and α-Pienene (leaf), Bulnesol and ъ-Cadinol (flower), Z-Propenyl sec-butyl disulfide, ъ-Cadinol and α-Pienene (premature seed) and Z-Propenyl sec-butyl disulfide and α-Pienene (ripe seed) (Dastan, 2011).

It had already been supposed that both bitter and sweet asafetida plants are obtained from *Ferula assa-foetida* and environmental factors cause different tastes. Then, in field investigation and collecting them from their habitats, it was identified (Mozaffarian, 2007) in Iran. It was proved that *Ferula pseudalliacea* is bitter asafetida plant in Yazd province, Iran. Since there is less report about *Ferula pseudalliacea*, and its habitats characteristics, this study was conducted to introduce the plant for flora of Yazd province, try to preserve it from extinction and develop it in rangelands with similar conditions.

Materials and Methods

Study area

There are only two hot spot habitats of *Ferula pseudalliacea* (Borooieh & Chenarnaz) in Harat County, Yazd province, Iran. Borooieh (30˚00′27″ N, 54˚03′04″E) with the area of 7335 ha (operational area of 139 ha and Chenarnaz with the area of 8550 ha (operational area of 189 ha (30˚01′44″ N, 54˚02′10″E) are located 300 km south of Yazd city. The average altitude is 2350 m above sea level. The mean annual precipitation is 214 mm and the mean annual temperature is 18.8˚C. Soil texture is sandy loam without considerable salinity. The dominant species is *Artemisia aucheri* in both regions. The other species *Noea mucronata*, *Astragalus sp.*, *Stipa barbata*, *Ebenus sp.*, *Ephedra strobilacea*, *Cousinia sp*. and *Amygdalus lycioides* grow in the region. Fig. 1 shows *Ferula pseudalliacea* in its natural habitats in Yazd province, Iran. Bitter Asafetida is extracted by root cutting in different stages. Different stages of gum harvesting are shown in Fig. 2.

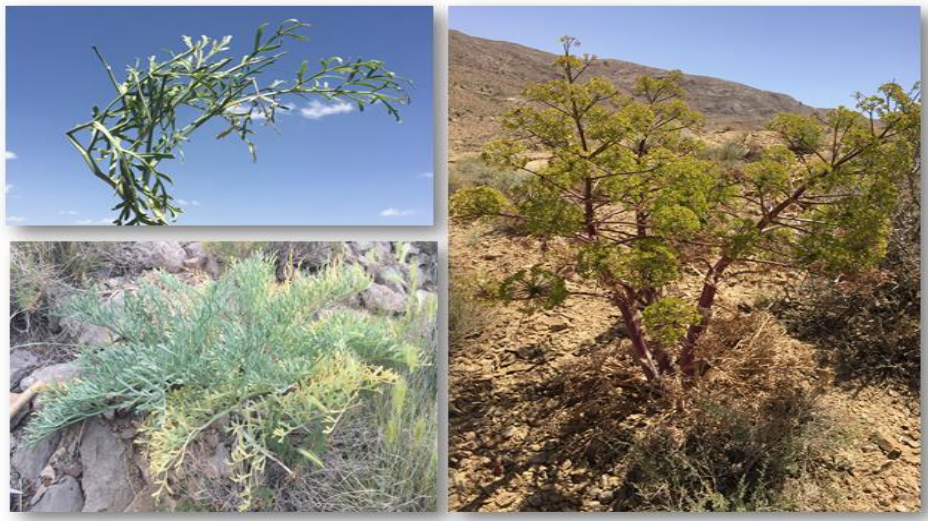

Fig.1. *Ferula pseudalliacea* plant in natural habitats in Yazd province (By author, 2016 & 2017)

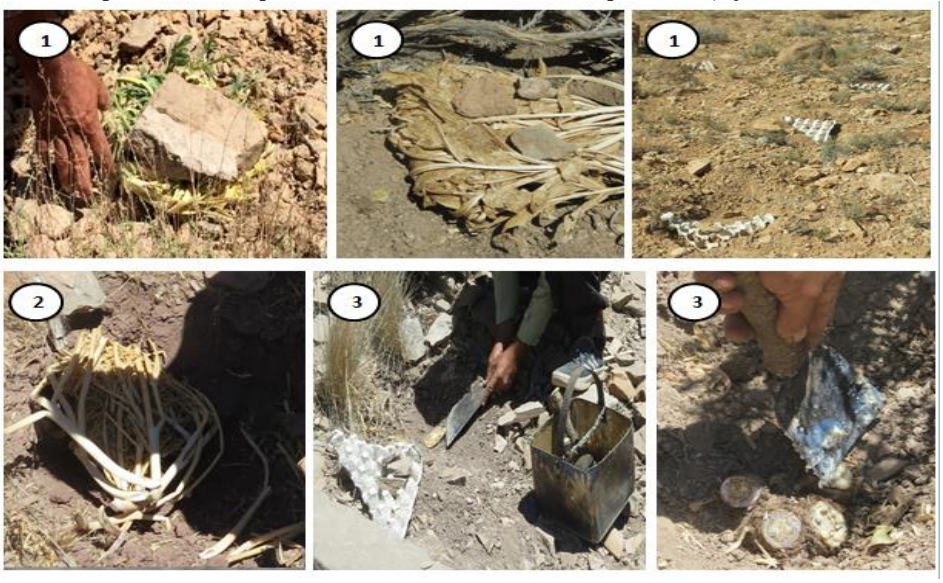

Fig.2. Different stages of gum harvesting in bitter asafetida (*Ferula pseudalliacea*). 1) Twisting aerial parts and marking its place, 2) Pulling over the soil and sunshade making before cutting, 3) Cutting in order to get gum (By author, 2016 & 2017)

Methodology

The study areas were determined using topographic maps and field investigation. In order to investigate plant phenology, 20 plants were randomly selected and marked using GPS. They were checked every 10-15 days to record different phenological stages in 2016 and 2017 (Pirmoradi, 2012; Noedoost *et al.*, 2018).). This research was performed in drought period when temperature was higher than its average. Vegetation sampling was done using random systematic method. According to vegetation type and condition, 15 random transects of 100m and 2 plots of 25 m^2 were systematically placed on each transect (30 plots in each site). Transects were chosen to determine the exact way of sampling (from north to west and east to west) in order to cover different aspects. Appropriate numbers of plots were calculated using the following statistical formula

$N= t^2s^2/p^2x^2$

Where:

N the number of samples required,

(t) the student t in table with the desired probability level (5%),

(x) the average primary sample,

(p) error limit that usually equals to +0.1 and -0.1,

(s^2) primary sample variance (Mesdaghi, 2003)

The plot size was determined according to *Ferula pseudalliacea* characteristics (vegetation type and condition) (Mesdaghi, 2003; Moghaddam, 2009) and previous experience in the region with the same condition (Sepehry and Hossein Jafari, 2016). Sampling was performed in the way that could cover most of plant species distribution. Some parameters such as canopy cover percent and density of the important species were determined in *Ferula pseudalliacea* habitats. Canopy cover percent of *Ferula pseudalliacea* was also determined in order to investigate plant distribution in different aspects (north, south, east and west) and different elevation levels (2200-2300, 2300-2400, 2400-2500 m). The rest of sampling was done in sites with higher canopy cover percent (according to the aspect and elevation). All conditions except soil were the same. For morphological traits, 20 random *Ferula pseudalliacea* plants were selected to determine leaf length, leaf width, plant area, flowering stem height, collar diameter, thousand seed weight, number of umbels and number of small umbels in each umbel.

Soil sampling was done using a completely randomized method (20 samples in each site) at the depth of 0-30 cm (according to the depth of root development and low depth of mountainous area). Soil parameters such as soil texture (hydrometric method), saturation moisture percent (by oven), pH and electrical conductivity (using pH and EC meter in saturated mud) (Mclean, 1988), organic matter (Walkley-Black method) (Nelson & Sommer, 1982), calcium carbonate (titration method), nitrogen (Kjeldahl method), phosphorous (by spectrophotometer) and potassium (by flame photometer) were measured in the laboratory (Jafari Haghighi, 2003).

The collected data of aspects and elevation were analyzed by performing analysis of variance (ANOVA) and a comparison between habitats was made using independent sample t-test and SPSS software.

Results

The results showed that phenological stages of *Ferula pseudalliacea* were extremely under the effect of climate conditions involving precipitation and temperature according to Heart weather station. Plants reduced their growth in dry years and adapted with undesirable environmental conditions. Based on the evaluation, the mean annual precipitation is 214 mm. Precipitation consists of snow, hail and mainly rain. The highest precipitation is in mid-January and the lowest is from mid-June to October. Maximum and minimum monthly temperatures are 30.5˚C and 6.6˚C, respectively. Dryness period started from the second half of April until November (7 months of a year).

The results of phenology studies showed that there was a correlation between phenological stages and the main climate indices such as temperature and precipitation. The Initial and vegetative growth was started from mid-March according to increasing soil moisture and gradual warming of the weather and soil. The plant goes to flowering stage when temperature increases and the days become longer. Flowering stage was started from mid-April to the mid of May. Seeding stage starts in the late May until early June. Seed maturity and seed dispersal occurred in June. The plant is completely dried with maximum temperature (in the mid of June) and it continues until the next year mid-March (Table 1). The plant is regenerated via seed dispersal. Climatic conditions and moisture affect the seed germination and establishment. In order to preserve and survive, seed production of this species is considerable.

There were no pest and diseases in this plant. It has applicable relative resistance

for its pungent smell and essential oil. But the root of this plant was sometimes attacked by several rodents like gerbils.

Table 1. Phenology stages of *Ferula pseudalliacea*

Stages	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Initial and vegetative growth												
Flowering												
Seeding												
Complete dryness												
Temperature average (˚C)	12.9	16.6	22.3	27.2	30.5	29.1	26.2	21.4	14.8	9	6.6	8.6
Precipitation average (mm)	31.8	39.0	7.3	0.5	1.2	0.8	0.6	0.5	8.6	39.9	46.2	37.7

Habitat characteristics

This species grows in slopes higher than 25%. But in the northern slopes, its distribution was higher than southern slopes. Maximum and minimum elevations in the habitats are 2500 and 2200 m, respectively.

The results of ANOVA showed significant effect of both aspects and elevation on canopy cover percent of *F. pseudalliacea* in both habitats ($p<0.01$). The highest canopy cover in both habitats was obtained in the north aspect with average values of 3.13% and 2.55% in Chenarnaz and Borooieh habitat, respectively. The lowest canopy cover percent was obtained in south aspect with average values of 1.65% and 1.65% in Chenarnaz and Borooieh habitat, respectively. There was no significant difference between eastern and western aspects in both habitats (Table 2).

Result of means comparison indicated that there was a significant difference among different elevation levels in terms of *Ferula pseudalliacea*, and the highest canopy cover percent was obtained in altitude of 2300-2400 m in both habitats. There was no significant difference between two higher and lower elevation levels in Chenarnaz habitat. The lowest canopy cover percent was obtained in altitude of 2400-2500 m in Borooieh habitat (Table 2).

Table 2. Effect of aspects and elevation on *Ferula pseudalliacea* canopy covers percentages in two habitats.

Aspect	Chenarnaz	Borooieh
North	3.13 [a]	2.55 [a]
East	2.13 [b]	1.91 [b]
West	2.07 [b]	1.88 [b]
South	1.65 [c]	1.65 [c]

Elevation	Chenarnaz	Borooieh
2200-2300 m	2.90 [b]	2.40 [b]
2300-2400 m	3.42 [a]	2.55 [a]
2400-2500 m	2.85 [b]	2.30 [c]

Means within column followed by same letters were not significantly different based on Duncan test at P = 0.05.

Vegetation parameters

Vegetation analysis showed that *Artemisia aucheri* was the dominant species in both habitats. *Ferula pseudalliacea* was ranked as the second species for canopy cover percent (Table 3).

Result of means comparison between two habitats indicated that higher and lower canopy cover percent of *Ferula pseudalliacea* with average values of 3.12% and 2.55% was obtained in Chenarnaz and Borooieh area, respectively. Similarly, higher and lower plant densities of *Ferula pseudalliacea* with average values of 825 and 825 plant/ha were obtained in Chenarnaz and Borooieh area, respectively (Table 3).

Results showed significant differences between two areas for some morphological parameters such as plant area, collar diameter ($p<0.01$) and thousand seed weight ($p<0.05$) so that the amount of these parameters was significantly increased in Chenarnaz area than that in Borooieh. There was no

significant difference between two regions in terms of leaf length, leaf weight, flowering stem height, number of umbels and umbellets number per umbel (Table 4).

Table 3. Canopy covers percent and plant densities (No/h) of the most important species in *Ferula pseudalliacea* habitats.

Species Name	Canopy Cover (%)		Density (No/ha)	
	Chenarnaz	Borooieh	Chenarnaz	Borooieh
Artemisia aucheri	9.85	8.32	8593	8737
Astragalus sp.	2.50	1.90	625	485
Ferula pseudalliacea	**3.12**	**2.55**	**950**	**825**
Ebenus sp.	0.90	1.07	174	225
Stipa barbata	0.43	0.27	2812	1125
Noea mucronata	0.61	0.32	312	125
Annuals like *Bromus sp.*	0.12	0.07	481	250
Acantholimon sp.	1.85	0.57	468	175
Eremurus persicus	0.31	0.09	937	264
Ephedra strobilaceum	0.60	1.78	156	625
Centaurea virgata	2.40	0.55	781	325
Zataria multiflora	0.01	0.05	58	125
Amygdalus lycioides	0.30	0.30	2.00	2.00
Convolvulus fruticosus	1.93	0.81	625	365
Cousinia sp.	1.70	0.90	481	275
Total	26.88	19.55		

Table 4. Means of canopy cover percent, plant density and some morphological characteristics of *F. pseudalliacea* in two habitats using independent sample t-test

Vegetation parameters	Chenarnaz	Borooieh	T values
Canopy Cover (%)	3.12	2.55	6.38 **
Density (number/ha)	950	825	48.41 **
Leaf length (cm)	40.95	39.15	1.697 ns
Leaf width (cm)	24.20	23.50	0.633 ns
Plant area (cm^2)	10809.7	10602.2	3.334**
Flowering stem height (cm)	162.60	156.95	0.840 ns
Collar diameter (cm)	7.05	6.65	3.32**
Thousand seed weight (g)	15.72	15.51	2.726*
Number of Umbels	31.55	30.80	0.599ns
Number of umbellets per umbel	13.10	12.45	0.964ns

ns, * and **= Non significant and significant at 5% and 1% probability levels

Soil parameters

According to field investigation and laboratory results, *Ferula pseudalliacea* grows often in mountainous regions with calcareous formation. Soil texture was sandy loam with 1.20-1.97% organic matter. Soil in the plant habitats was shallow, gravelly and calcareous without noticeable salinity.

There were significant differences between the two habitats in terms of saturated moisture, silt and sand percent ($p<0.01$) so that higher values of saturated moisture and silt percent were in Chenarnaz region (41.39% and 30.20%), respectively as compared to Borooieh (35.49% and 24%), respectively whereas for sand percent, higher values were observed in Borooieh habitat. There was no significant difference between two regions in terms of clay and calcium carbonate (TNV) percent. The results of comparing soil chemical parameters indicate that there were significant differences between two habitats for EC, pH and organic matter ($p<0.01$). Higher values of (pH=8.23) and organic matter (1.97%) were observed in Chenarnaz than that for Borooieh habitat with average values of 8.09 and 1.20%, respectively. In contrast, higher value of EC was observed in Borooieh area (Table 5).

Table 5. Means of soil physic-chemical parameters in two habitats of *F.pseudalliacea* using independent sample t-test

Vegetation parameters	Chenarnaz	Borooieh	t
Saturated moisture (%)	41.39	35.49	5.33**
Silt (%)	30.20	24.0	4.84**
Sand (%)	53.0	60.0	-11.07**
Clay (%)	16.80	16.0	1.21ns
EC (ms/m)	0.38	0.54	-4.73**
pH	8.23	8.09	6.36**
TNV (%)	58.27	55.92	1.86ns
OM (%)	1.97	1.20	21.30**

ns, * and **= Non significant and significant at 5% and 1% probability levels

Discussion and Conclusion

Plant species of arid and semi-arid regions are so important for their compatibility to severe environmental conditions. *Ferula pseudalliacea* is one of endemic medicinal plants in Iran that its gum is utilized as bitter asafetida exported to other countries. There were only two natural habitats of this valuable species in Yazd province, Iran. The results of this study indicated that *Ferula pseudalliacea* phenological activities are affected by climate conditions like precipitation and soil moisture. Sharifi Yazdi *et al.* (2009) studied autecology of *Ferula oopoda* in Kerman province and demonstrated that phenological stages in the sites with higher elevation started later than lower regions. Noedoost *et al.* (2018) found that phenology stages of *Ferula stenocarpa* depend on soil moisture and temperature, which confirmed the results of this study.

Ferula pseudalliacea grows in all aspects and in slopes higher than 25%. The results showed that this species had the highest canopy cover percent and density in the north aspects and the lowest canopy cover percent in the south aspects. In general, temperature and evapotranspiration increase from north to the east, west and the south in northern hemisphere. Therefore, moisture content in north aspect is higher than other aspects. Mahmoudi *et al.* (2015) stated that the north aspect had deeper soil having higher organic matter and denser vegetation, so higher canopy cover percent and distribution of *Ferula pseudalliacea* in north aspect are reasonable. Sharifi Yazdi *et al.* (2009) and Pirmoradi (2012) had also reported that *Ferula oopoda* and *Ferula assa-foetida* densities and succulence in northern slopes were higher than southern area. Their studies were done in Kerman province with nearly the same climate to Yazd.

Ferula pseudalliacea is often observed besides other species like *Artemisia aucheri* and *Astragalus sp*. The mean annual precipitation is 212 mm and the mean annual temperature is 15˚C. Its habitat is located in altitudes of 2200-2500 m above sea level. The results revealed that the highest and lowest canopy cover percent was observed in the altitude of 2300-2400 and 2400-2500. It can be related to decreasing some parameters such as temperature, soil depth, soil fertility and water infiltration in higher elevation levels. Ebrahimi kebria (2002) and Saghari *et al.* (2016) stated the same reasons in their studies. Since *Ferula pseudalliacea* needs calcareous soils with good drainage, its distribution depends on changing these parameters. Mahmoudi *et al.* (2015) had the same reasons about *Ferula gummosa* distribution in different elevation levels.

In general, environmental factors play an important role in medicinal plants growth and production; these parameters are under the effect of soil properties in the habitats with the same climatic and topographic conditions (Arzani, 2012). In this study, canopy cover percent, density, plant area, collar diameter and thousand seed weight of bitter asafetida had higher mean values in Chenarnaz than those for

Borooieh habitat. Therefore, according to the above reasons, the difference between canopy covers of species in two habitats is related to soil characteristics. Soil texture affected nutrients absorbance, permeability, ventilation and the amount of available water for plants and plays an important role in plant species distribution (Sperry & Hacke, 2002; Mirzaei Mousavand *et al.*, 2016). Soils of both habitats were sandy loam but there was a significant difference between two habitats in terms of soil texture like silt and sand. Sand percent in Borooieh habitat was high while in Chenarnaz, soil moisture and silt percent were higher. So increasing soil water storage of Asafetida rangelands may cause to increase vegetation parameters. Pirmoradi (2012) stated that enough water in growing seasons of plants causes increasing photosynthesis, leaves length and canopy cover percent. Soil chemical properties are also effective factors in plant growth and production (Yazdanshenas *et al.*, 2015). In this research, pH was high in Chenarnaz region. The ability of food elements absorbance depends on soil pH (Aghajanlou & Ghorbani, 2015). Acidity (pH) is an effective factor in Asafetida growth. This plant prefers calcareous soil. The higher amount of calcium carbonate in asafetida habitat led to more growth and production of the plants (Pirmoradi, 2012). Tahir *et al.* (2010) stated that the amount of calcium carbonate causes other elements absorbance such as phosphorous and increases plant growth and production. There was no significant difference between two habitats in terms of calcium carbonate, but its amount was higher in Chenarnaz area. Organic matter also was higher in Chenarnaz habitat (3.13% in Chenarnaz and 2.55% in Borooieh habitat). It can be due to more canopy cover percent of plants and finally more returning organic matter to the soil in Chenarnaz as compared to Borooieh habitat.

Consecutive droughts and unreasonable utilization of *Ferula pseudalliacea* gum (bitter asafetida) in Yazd province may cause this plant to become endanger. Therefore, it is essential to conserve and manage it using comprehensive program. The results of this study showed that specific ecological condition of Harat County can be one of the best regions for *Ferula pseudalliacea* growth. According to its medicinal and economic values of *Ferula pseudalliacea* plant, this study can be effective in restoration, cultivation and domestication programs of this species. Fundamental activities are needed to develop this valuable species in rangelands with desirable conditions.

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تأثیر توپوگرافی و خصوصیات خاک بر پراکنش گیاه *Ferula pseudalliacea* (آنغوزه تلخ) در استان یزد، ایران

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چکیده. گونه *Ferula pseudalliacea* (آنغوزه تلخ) یک گیاه دارویی بومی در مناطق مرکزی ایران است که در صنایع دارویی کاربرد فراوان دارد. مطالعات اندکی در زمینه خصوصیات رویشگاهی و پراکنش این گیاه در ایران انجام شده است. بنابراین پژوهش حاضر با هدف مطالعه تأثیر توپوگرافی و خصوصیات خاک بر پراکنش این گونه در استان یزد طی سال‌های ۱۳۹۵ و ۱۳۹۶ انجام شد. بدین منظور دو رویشگاه (چنارناز و بوروئیه) انتخاب گردید و نمونه‌برداری از پوشش گیاهی و خاک با روش تصادفی سیستماتیک صورت گرفت. تجزیه و تحلیل داده‌ها در نرم افزارSPSS انجام شد. نتایج حاکی از آن بود که این گیاه اغلب در مناطق کوهستانی و تشکیلات آهکی رشد می‌کند. فعالیت‌های فنولوژیکی این گیاه بشدت تحت تأثیر شرایط آب و هوایی است. این گونه در تمام جهت ها و شیب‌های بیش از ۲۵٪ رشد می‌کند. در منطقه چنارناز بیشترین درصد پوشش مربوط به جهت شمالی (۳٪/۱۳) و کمترین درصد پوشش با میزان ۱٪/۶۵ مربوط به جهت جنوبی بود. همچنین بیشترین میزان درصد پوشش این گیاه در منطقه بوروئیه در جهت شمالی (۲٪/۵۵) و کمترین آن در جهت جنوبی (۱٪/۶۵) مشاهده شد. طبقه ارتفاعی ۲۳۰۰-۲۴۰۰ متر دارای بیشترین درصد پوشش در هر دو رویشگاه بود، بطوری که میزان آن در منطقه چنارناز ۳/۴۲٪ و در منطقه بوروئیه ۲/۵۵٪ بدست آمد. در رابطه با بسیاری از پارامترها در دو رویشگاه اختلاف معنی‌دار وجود داشت. بیشترین میانگین درصد پوشش، تراکم، سطح تاج پوشش، قطر یقه، وزن هزاردانه و عوامل خاکی از قبیل درصد رطوبت اشباع، سیلت، pH و مواد آلی در منطقه چنارناز مشاهده شد و بیشترین میزان درصد شن و EC در رویشگاه بوروئیه بدست آمد. نتایج نشان داد که این گونه در خاک‌هایی با میزان آهک ۵۵/۹۲٪ تا ۵۸/۲۷٪ و بافت شنی لومی، اسیدیته ۸/۲۳-۸/۰۹ و میزان مواد آلی بین ۱/۲۰٪ تا ۱/۹۷٪ رشد می‌کند. نتایج حاصل از این مطالعه می‌تواند بمنظور مدیریت مناسب، حفاظت و توسعه این گونه باارزش در مراتعی با شرایط مشابه مورد توجه قرار گیرد.

کلمات کلیدی: آنغوزه تلخ، تاج پوشش، شرایط اکولوژیکی، بافت خاک