

Geospatial Survey of the Cultivation of the Medicinal Plant *Prangos ferulaceae* in Kohgiluyeh & Boyer-Ahmad Province

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Abstract

The medicinal plant *Prangos ferulaceae* is considered one of the most valuable forage, protective, medicinal, and industrial plants in Iran. A significant part of plant species, including *Prangos ferulaceae* in Kohgiluyeh & Boyer-Ahmad province, have been exposed to damage and extinction for various reasons in recent years. In order to preserve it, some measures such as planting the species in fields or creating a pilot for preservation, its maintenance, propagation, and breeding are an urgent and necessary requirement. But its realization requires ecological studies and knowledge, such as identifying the potential of areas prone to optimal production of *Prangos ferulaceae*, which requires the location measurement of *Prangos ferulaceae* planting. According to climate zoning using factor-cluster analysis, this plant can be in the first zone (cold mountainous with heavy rainfall, including Yasouj and Sisakht stations as well as the Tang Khoshk region), the fourth zone (cold and semi-rainy, including the northern areas of Dena city and Pataweh station) should be planted and cultivated, but this plant cannot be planted in the eighth region (semi-warm and semi-arid north), including Dishmuk, Qale Raisi, and Charrosa. Also, this plant can be cultivated in the third region (central semi-arid and semi-temperate) includes Kabkian, Lodab, central Dehdasht, and Souq, and the sixth region (temperate semi-arid), which includes Margun. In the fifth area (very hot and humid tropical), including Babakallan and Bibi Hakimeh stations, and in the seventh area (hot and dry), including Likak, Mombi, and Sar Asiab Yousefi, the *Prangos ferulaceae* plant cannot be cultivated either.

Keywords: Cultivation, Geospatial, Iran, Kohgiloye & Boyer-Ahmad, *Prangos ferulaceae*

Introduction

Plants are the world's valuable genetic resources. It is predicted that more than 15 to 40 percent of living species (plants

and animals) will become extinct by 2050 (Tohidfar and Haji Barat, 2016). Studies on endangered species and the

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conservation of genetic resources globally have been seriously discussed since 1960, and international organizations have been formed in this regard (Tohidfar and Haji Barat, 2016). Due to its special geographical location, Kohgiluyeh and Boyer-Ahmad Province is home to various plant species, some of which are unique and can only grow in this province, so that this province is home to 2100 plant species, which includes 28% of Iran's plant species. Of these, 425 species are medicinal plants, but in recent years, a significant part of these species have been at risk of extinction for various reasons (Fatahi and Khoshdali, 2016).

According to the results of a study (Naghipour Borj et al., 2014), *Prangos ferulacea* is at risk of damage and extinction in the mentioned province. Among the medicinal plant species, *Prangos ferulacea* (Figure 1), from the Asteraceae family, is one of the best rangeland plants in Iran, and its reproduction is at risk due to unprincipled use (Safaiyan and Azarnivand, 2010). The preservation of this species and its associated ecosystem requires meticulous scientific research. The significance of *Prangos ferulacea* rangeland plant lies in its ability to protect soil, regulate air quality, and enhance regional greenery. Its propagation through seeds with the lowest maintenance cost has doubled the economic and rangeland importance of this plant (Abdul Razzaq, 1989). Research on the nutritional value of *Prangos ferulacea* has shown that this plant can be used as a high-energy forage for livestock (Coskun et al., 2004). In plant classification, the *Prangos ferulacea* plant belongs to the class Dicotyledoneae,

subclass Rosida, order Umbellales, family Apiaceae, and genus *Prangos*. The genus *Prangos* is part of the subfamily Apioideae, which is within the family Apiaceae. This genus comprises 15 species of aromatic and forage perennial herbaceous plants in Iran (Mehregan and Sajjadi, 2003). The genus *Prangos* Lindl. belongs to the Asteraceae family, and there are 15 species of it in Iran. Three species of this plant, consisting of *Prangos acaulis*, *Prangos platychloena*, and *Prangos ferulacea*, are found in two provinces, including Fars and Kohgiluyeh and Boyer-Ahmad (Azarkish et al., 2018). *Prangos* Lindl. is a medicinal plant native to the southern regions of Iran that is used in traditional medicine to treat the majority of digestive disorders (Azarkish et al., 2018). By reviewing the studies, it was found that the *Prangos ferulacea* plant possesses several medicinal effects, such as antioxidant, antimicrobial, analgesic, antispasmodic, and antidiabetic. The results showed that this medicinal species contains valuable natural compounds. It contains coumarins, flavonoids, glycosides, and essential terpenoids. By reviewing the studies, it was found that the *Prangos ferulacea* plant has several medicinal effects, such as antioxidant, antimicrobial, analgesic, antispasmodic, and antidiabetic, which have been proven in in vitro and animal studies (Bahadori et al., 2022). The traditional application of the *Prangos ferulacea* plant has been identified in the treatment of numerous diseases, along with the presence of valuable herbal and medicinal compounds. As a result, this plant can establish a basis for the exploration of herbal medicines in the production

of antibiotics, painkillers, and diabetes treatment drugs, thereby provide scientists with keys to conducting clinical trials (Kafash-Farkhad et al., 2013). Moreover, ecological studies of plant are considered both applied and fundamental research in the management of plant utilization (Fathi et al., 2022). Additionally, the location survey of the edible medicinal plant *Prangos ferulacea* (Figure 1) in Kohgiluyeh and Boyer-Ahmad province, which is based on climatic zoning, represents one of the applied and fundamental strategies to preserve this species and ensuring its survival within the ecosystem. Certainly, the importance of conducting a location survey lies in the identification of native plants that are compatible with ecosystems facing various environmental stresses.

Material and methods

In the present study, the local topography of the mentioned plant was investigated using knowledge of the medicinal plant *Prangos ferulacea* along with its ecology, as well as geographical, climatic, and weather conditions of Kohgiluyeh and Boyer-Ahmad

province, and the different climatic zoning of Kohgiluyeh and Boyer-Ahmad province (Fig. 1).

Geographical, climatic, and weather conditions of Kohgiluyeh & Boyer-Ahmad Province

Kohgiluyeh & Boyer-Ahmad Province, with an area of 264.16 km², is located between 30° 9 ' to 31° 32' north latitude and 49° 57' to 50° and 42' east longitude in southwestern Iran. It is bordered by Chaharmahal & Bakhtiari Province to the north, Fars and Bushehr Provinces to the south, Isfahan and Fars Provinces to the east, and Khuzestan Province to the west (Figure 2).

The peak of Mount Dena, reaching an elevation of 4,409 meters, represents the highest point in the province, while its lowest point is Lishtar, situated at an altitude of 500 meters above sea level. Kohgiluyeh & Boyer-Ahmad Province is a characterized by its relatively high mountainous land surrounded by the Zagros Mountains. It features parallel ranges to the north and east, along with the Black and White Mountains, Khomi Khaiz, and the Nile to the southeast. The Maroon, Bashar, Zohreh, Khersan,

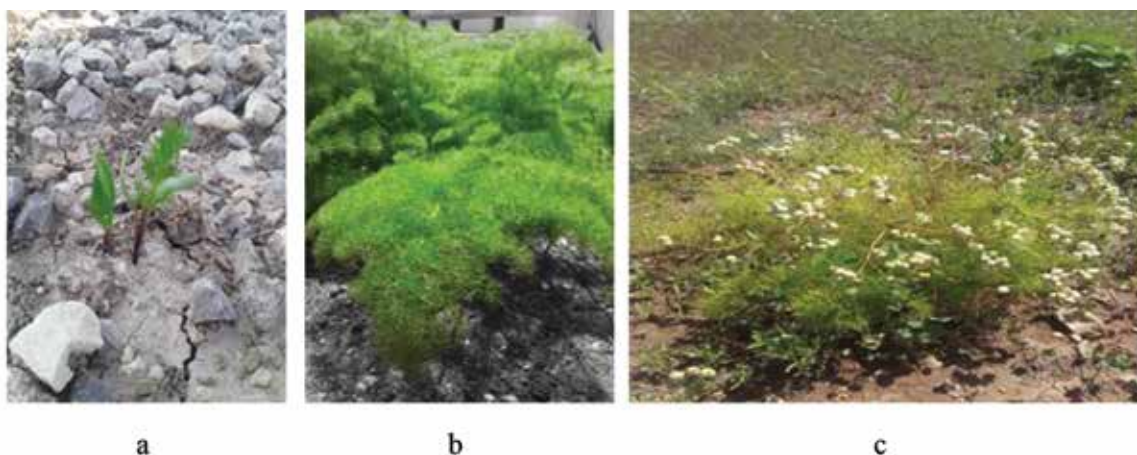


Fig. 1. a, b, and c; *Prangos ferulacea* habitats in different stages of growth from annual to perennial

and Nazmakan rivers pass through this province, and its highlands are the source of several rivers. Approximately 90% of the area of the region consists of highlands and hills. In cold regions, there are higher altitudes and more rolling hills, and in hot regions, there are lower altitudes and fewer rolling hills. Plains also make up about 20% of the province's area, and most agricultural land is usually located in the plains. Due to the province's geographical conditions, the height of the mountains, as well as the amount of rainfall and humidity, decrease noticeably from the northeast to the southwest along the main stretch of the Zagros Mountains. This natural situation has created dual climatic characteristics and divided the province into two cold and tropical regions (Environmental Protection of Kohgiluyeh & Boyer-Ahmad, 2013):

Tropical region of the southern and western province

This region is located in the southern and western parts of the province, covering over 8000 km², and experiences a hot and semi-arid climate. Rainfall commences in

November and continues intermittently until May. In contrast to the colder region of Kohgiluyeh & Boyer-Ahmad province, the amount of rainfall is relatively low. Frost occurrences are also infrequent in these region. This section of Kohgiluyeh & Boyer-Ahmad province is rich in mountainous pistachio trees (Environmental Protection of Kohgiluyeh & Boyer-Ahmad, 2013).

Cold highland zone of the northern and eastern province

This zone, encompassing an area of more than 6500 km² and situated at an average altitude of approximately 2100 m above sea level, is located in the northern and eastern parts of the province and adjacent to the provinces of Fars, Isfahan, and Chaharmahal & Bakhtiari. The average temperature in this region fluctuates from 36 °C during the warmest months to -10 °C in the winter season. Precipitation in this area typically begins in November and continues intermittently until May, with the majority of the precipitation occurring as snowfall. This section of the province, which represents the southernmost extent of the of

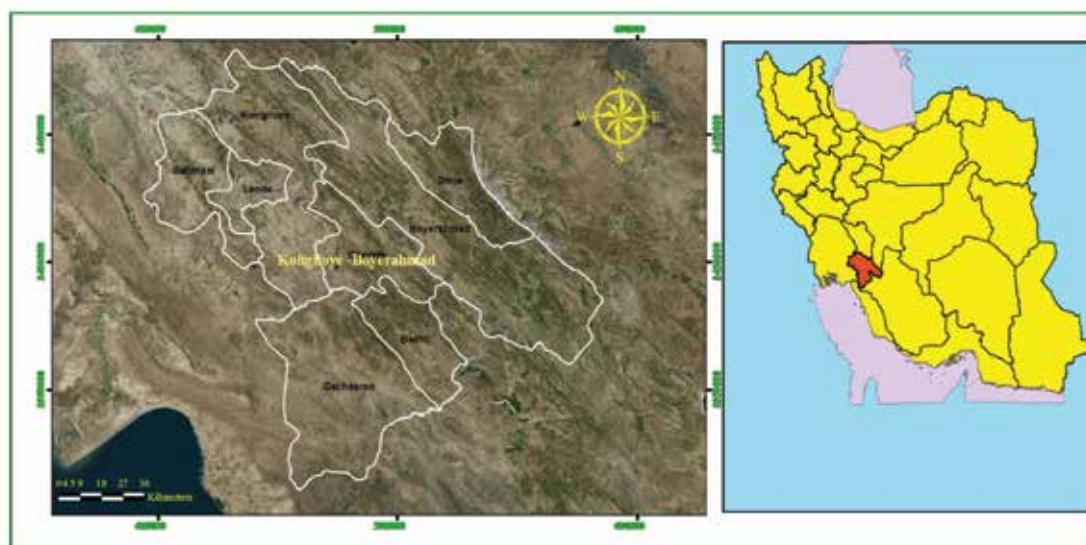


Fig. 2. Geographical location of Kohgiluyeh & Boyer-Ahmad Province

the humid Zagros, is covered with extensive and picturesque oak forests and serves as the origin for significant, high-flowing rivers such as the Karun and Marun.

The frost season in the region initiates in September in certain locations and lasts until late March. The absolute maximum relative humidity reach 100 percent in April, December, and February, while the absolute minimum relative humidity recorded in August and September is 57% and 63%, respectively. The maximum rainfall in April measures 203.6 mm, whereas the minimum rainfall amounts in August, September and November are 0.3, 0.1 and 0.4 mm respectively. In Yasuj city, the number of frost days' totals 45 days, with the highest occurrences noted in February and January (Environmental Protection of Kohgiluyeh & Boyerahmad, 2013).

In the province of Kohgiluyeh & Boyerahmad, winds blow from various directions, with the most significant of which that is Monsoon winds. These relatively strong winds are known as the north wind and the south wind. The north wind is a wind that penetrates the region from the northwest, originating from the Mediterranean Sea and occasionally from the Atlantic Ocean. This wind moves in the direction of the passing of rain-producing clouds that enter the region from Lorestan Province, resulting in precipitation during the winter. Conversely, the south wind is another monsoon wind that penetrates the region from the south and southwest, particularly in late spring and summer. This wind brings excessive heat and dryness, often leading to extensive damage to the

region's fields and agricultural products (Environmental Protection of Kohgiluyeh & Boyerahmad, 2013).

Local wind regimes of the province

In addition to the north and south monsoon winds that blow throughout the region, other winds occur in various relatively small and limited areas of the province, referred to as local winds. The most significant local winds are classified into five types. The chaos wind, which blows at the Upper Boyer Ahmad River, collects all the thorns, brushwood, and dry grass in the region and carries them away. This wind is also present in the tropical Lower Boyer Ahmad River, although it does not have a specific direction. The second wind is known as wind under the sun, which blows from the west in the Bahmei Ahmadi region at sunset. The mountain wind, which originates from the northwest of the Bahmei Ahmadi region, is the third type, serving as the tail of the same wind. The surprised wind, which blows from the east in BoyerAhmad is another wind. The final wind is Bad Choghan, the strongest local wind, typically blowing in the Saqhawah of Lower Boyer Ahmad. This wind originates from the north during winter and can sometimes blow with significant intensity for up to seven days and nights (Environmental Protection of Kohgiluyeh & Boyerahmad, 2013).

The mountainous conditions of Kohgiluyeh & Boyerahmad province have led to a rich ecological and biological diversity of plants and animals. The elevation ranges of 500 to 4,000 m above sea level, along with temperature variations from -10 to 45 °C, demonstrate the wide range of tolerance of

plant and animal species to survive in this region. In addition to providing some of the wood required by villagers and fodder for livestock, the existing plant species also play a crucial role in generating by-products, including gum, resin, flowers, fruits, nuts, seeds, roots, and leaves, which are frequently utilized for medicinal and industrial purposes (Environmental Protection of Kohgiluyeh & Boyerahmad, 2013).

Climatic zoning of Kohgiluyeh & Boyerahmad Province

According to the climatic zoning, Kohgiluyeh & Boyerahmad province is divided into eight climatic zones. The first zone omprises cold mountainous with high precipitation. This zone, which includes the stations of Yasouj and Sisakht, experiences the highest levels of precipitation among the eight zones. This zone, covering approximately 11% of the province's area, it spans about 2311 km². Zone 2 characterized by warm and semi-arid weather, which includes the stations of Dogonbadan, Basht, Ab Shirin, Dale, Cheram, and Lister. It encompasses an average temperature of 21 °C and an annual rainfall of 437 mm that occupies around 3,121 km² of the province's area, accounting for 23.1%. Zone 3, Moderate Semi-Arid, including Margoon, covers an area of about 2271 km² of the province, with 14.5%. It has an average temperature of 13 °C and 434 mm of rainfall. Zone 4 encompasses the northern areas of Dena County and Patavah Station with about 2.7% coverage or approximately 1,121 km². This zone characterized by cold and semi-rainy, making it the coldest region among these zones, with fewest dusty days. Additionally, it experiences the second-

highest rainfall in the province, following zone one, which is known for its cold, mountainous and rainy climate.

Zone 5 classified as very hot and humid, tropical includes the Babakalan and Bibi Hakimeh stations. It records the highest average temperature at 24 °C. This zone occupies the smallest area at about 1000 km², representing 6.4 percent of the total. The average relative humidity in this zone is 48%, the highest among all zones. Zone 6 known as Central Semi-Arid and Semi-Temperate, comprises Quebecian, Lodab, Central Dehdasht, and Souq, covering about 14.5% of the province's area. The average temperature in this zone is 20 °C with an annual average rainfall of 508 mm. Zone 7 identified as hot and dry includes Liqak, Mombi, and Sar-Asyab Yousefi. This zone accounts for 11% of the province's area, approximately 1,725 km², and is characterized as by the highest average number of dusty days and the lowest average rainfall among the existing zones. Zone 8, referred to as Northern Semi-Hot and Semi-Arid, is represented by Dishmok, Qalea-e-Raisi, and Charrosa, covering 8.5% of the province with an area of 1325 km². The average temperature in this region is 21 °C, and it receives an annual rainfall of 444 mm (Salehi et al., 2017).

Results and discussion

According to the climatic zoning using factor-cluster analysis, Kohgiluyeh & Boyerahmad province is categorized into eight climatic zones. *Prangos ferulacea* can be placed in zone one (Fig. 2) (Salehi et al., 2017). This zone, which encompasses

the stations of Yasouj and Sisakht stations, experiences the highest level of precipitation among the eight designated zones. The rate of plant growth/height (cm) in the Chamkhani Station research farm in Yasouj city, Boyer Ahmad County, which is located in Region 1, from March to May 2023. This plant was destroyed in June, and therefore there is no growth to report for this month, which is why it was not plotted on the Graph (Fig. 3).

This zone covering 11% of the province's total area, which spans about 2311 km² (Salehi, et al., 2017). The cultivation and planting of *Prangos ferulacea* can be undertaken in the Tang Khoshk region of Yasouj, situated in Kohgiluyeh & Boyer-Ahmad province in zone 1 (Figure 2), (Salehi et al., 2017). Additionally, *Prangos ferulacea* is present in both the eastern and western Dena regions of Yasouj city, as well as in Boyer-Ahmad and Dena counties within the same province, which is classified in zone 1 of the climatic zoning based on factor-cluster analysis (Figure 2), (Salehi

et al., 2017). Furthermore, this plant can be cultivated in zone 4, characterized as cold and semi-rainy, including the northern areas of Dena County and Pataveh Station. It covers about 2.7%, or approximately 1,121 km² of the province's area. This zone recognized as the coldest among various zones and experiences the least number of dusty days. Notably, zone 4 which is known as cold and semi-rainy region following zone one (cold, mountainous, and heavy rainfall) in terms of the highest rainfall recorded in the province (Salehi et al., 2017). However, it is important to note that this plant is unsuitable for cultivation in zone eight, with a semi-warm and semi-arid northern climate. It includes Dishmok, Qale-Raisi, and Charrosa, covering 8.5% of the province's area and has an area of 1325 km². The average temperature in this zone is 21 °C, with the annual rainfall being 444 mm (Salehi et al., 2017).

Certainly, this plant is also appropriate for placement in both zones 3 and 6, which is characterized as central semi-arid and semi-

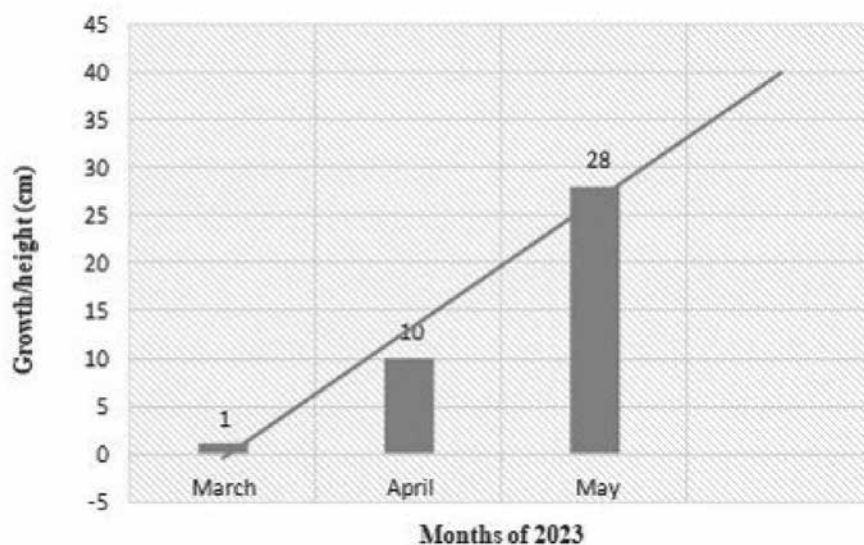


Fig. 3. The growth-to-height ratio (cm) of the *Prangos ferulacea* plant throughout the growth months of 2023

temperate, includes Qabkian, Lodab, central Dehdasht, and Souq, accounting for 14.5% of the province's total area. The average temperature in this zone is 20 °C, with an annual average rainfall of (Salehi et al., 2017). Zone three identified as temperate semi-arid: includes Margoon and also presents 14.5% of the province's area of, which is about 2271 km². This zone has an average temperature of 13 °C and receives an average rainfall of 434 mm (Salehi et al., 2017). *Prangos ferulacea* has not been reported in zones five and seven. Based on climatic zoning through factor-cluster analysis (Figure 2), (Salehi et al., 2017). The province of Kohgiluyeh and Boyer-Ahmad, specifically zone 5 characterized as very hot and humid tropical, including Babakalan and Bibi-Hakimeh stations, has the highest average temperature about 24°C. This region constitutes the smallest percentage of 6.4%, approximately 1000 km². The average relative humidity among those studied is 48%, making it as the region with the highest humidity among those studied (Salehi et al., 2017). Zone seven classified as hot and dry includes Likkak, Mombi, and Sar-Asyab Yousefi covering 11% of the province area, which is about 1725 km². This zone also records the highest average number of dusty days and the lowest average rainfall compared to other regions (Salehi et al., 2017). *Prangos ferulacea* is a member of the Asteraceae family and grows in remote mountainous areas at snow-covered elevations. This plant emerges from the ground in early spring after the snow melts in highlands and continues to grow until late May and early June. The main habitat

of *Prangos ferulacea* in Iran is the Zagros region. This plant has been observed in the provinces of Markazi, Fars, Kohgiluyeh & Boyerahmad, Chaharmahal & Bakhtiari, Isfahan, Kermanshah, Lorestan, Hamedan, Kerman and in certain areas of the Alborz mountain range. Various species of *Prangos ferulacea* found in Iran all possess significant forage value; making an appropriate candidate for cultivation in mountainous areas. The rainfall levels in the different places where *Prangos ferulacea* grows vary between 500 and 900 mm (Bostani, 2010). The amount of rainfall in different growth points of *Prangos ferulacea* varies between 500 and 900 mm. The germination time of *Prangos ferulacea* seeds is 7-25 days and the suitable temperature for germination is 18-25 degrees Celsius, the planting depth of this plant is one centimeter and with a planting distance between and on the row of 50 x 50 cm. *Prangos ferulacea* plant has antimicrobial properties and is known as a strong detoxifier. For this reason, it is used in traditional medicine to treat kidney diseases, nervous system, joint pain, bone tissue repair, epilepsy, bleeding, etc (Rahimi and Mohamadzadeh, 2025).

Conclusion

Prangos ferulacea is a medicinal plant native to the southern regions of Iran, utilized in traditional medicine for the treatment of various digestive disorders. Iran, with its historical heritage and potential geographical, climatic, and plant species diversity, can meet the needs of human society in the field of medicinal plants. Unfortunately, in recent years, a significant

portion of medicinal plant species, including *Prangos ferulacea*, have faced the threats of damage and extinction for multiple reasons in Kohgiluyeh & Boyer-Ahmad Province. There exists an urgent and critical need to protect endangered species, including *Prangos ferulacea*, from harm and extinction. This can be achieved through methods such as planting these species in agricultural fields and incorporating them into crop rotation, or by establishing a pilot program aimed at preserving, maintaining, propagating, and cultivating them. However, achieving this requires ecological studies and knowledge, such as identifying potential areas conducive to optimal production of the medicinal plant *Prangos ferulacea*. This requires determining the appropriate locations for planting *Prangos ferulacea* based on climatic zoning. According to climatic zoning derived from factor-cluster analysis, this medicinal plant can be cultivated in zone one characterized by cold mountainous with high rainfall, which encompasses the Yasouj and Si-Sakht stations, as well as the Tang-Koshk region of Yasouj. Additionally, *Prangos ferulacea* can also be cultivated in zone four identified as cold and semi-rainy, which includes the northern areas of Dena County and Pataveh Station. However, it is important to note that *Prangos ferulacea* cannot be grown in zone eight that is known as semi-warm and semi-arid north, which comprises Dishmook, Qale-e-Raisi, and Charrosa. Furthermore, this plant can be grown in zones three and six, which includes Kabkian, Lodab, central Dehdasht, and Souq, and zone three characterized by temperate and semi-arid, specifically including Margoon, and Prangos

ferulacea. The studied plant is unsuitable for cultivation in zones five referred as very hot and humid tropical, which includes Babakalan and Bibi-Hakimeh stations, as well as zone seven (hot and dry), which encompasses Likkak, Mombi, and Sar-Asyab Yousefi. The global trend towards utilizing medicinal plants and natural compounds has led to the overharvesting of certain species from their natural habitats. This, along with destructive harvesting methods, has led to the destruction or degradation of these habitats, posing a serious risk to the conservation of biodiversity. Consequently, an effective strategy to prevent the extinction of medicinal plant species is through their domestication. It was previously believed that regardless of the quantity of medicinal plants harvested, there would be a chance for natural regeneration. However, over the years, humanity has recognized that this conclusion is incorrect; plants in the nature can only regenerate when they are harvested within their productive capacity. Conversely, the exploitation of a plant's productive potential is rarely adequate to fulfill macro-economic goals. The solution to this issue lies in transferring a portion of the germplasm of medicinal plants from nature to agriculture settings, achievable through domesticating and cultivating of susceptible varieties.

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