

Utilisation Potential of Some Geophyte Taxa Naturally Occurring in Bingöl in Landscape Design

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Abstract

The plant material used in landscaping applications is of great importance not only for aesthetic elements but also in terms of ecological compatibility, sustainability, and economic value. Turkey, with its approximately 12,000 plant taxa, is one of the world's important centres in terms of biological diversity. Despite the presence of numerous endemic and natural species in the country, the preference for imported plant material in landscaping applications increases economic dependence on foreign sources and leads to the under utilisation of the rich local flora. This study aims to reveal the potential use of some geophyte taxa naturally distributed in Bingöl and its surroundings in landscape design. As a result of field studies and literature reviews, 150 geophyte taxa belonging to 14 families were identified. These taxa were evaluated according to certain criteria important for landscaping, such as endemism, showy flowers, pleasant fragrance, medicinal/aromatic use, shade tolerance, use in flower beds, soil tolerance, use in refuges, use near water, use for exhibition/display purposes, and use in rock gardens. The study determined that 56 geophyte taxa found in the Bingöl flora have high potential for use in landscape design. It is thought that these taxa could constitute an important alternative resource for sustainable landscape designs due to their ecological adaptability, low maintenance requirements and aesthetic characteristics. The findings contribute to the more effective use of the potential of the natural flora in landscape planning and implementation.

Keywords

Flora of Bingöl,
Geophyte plants,
Landscape Design,
Sustainability,
Use of Native
Plants

Bingöl'de Doğal olarak Yayılış Gösteren Bazı Geofit Taksonların Peyzaj Tasarımında Kullanım Potansiyeli

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Öz

Peyzaj uygulamalarında kullanılan bitki materyali, estetik öğelerin yanı sıra ekolojik uyum, sürdürülebilirlik ve ekonomik değer açısından da büyük önem taşımaktadır. Türkiye, sahip olduğu yaklaşık 12.000 bitki taksonu ile biyolojik çeşitlilik bakımından dünyanın önemli merkezlerinden biridir. Ülkede çok sayıda endemik ve doğal tür bulunmasına rağmen peyzaj uygulamalarında çoğunlukla ithal bitki materyalinin tercih edilmesi, hem ekonomik açıdan dışa bağımlılığı artırmakta hem de zengin yerel floranın yeterince değerlendirilememesine yol açmaktadır. Bu çalışma, Bingöl ve çevresinde doğal olarak yayılış gösteren bazı geofit taksonlarının peyzaj tasarımındaki kullanım potansiyellerini ortaya koymayı amaçlamaktadır. Arazi çalışmaları ve literatür taramaları sonucunda 14 familyaya ait 150 geofit takson tespit edilmiştir. Bu taksonlar; endemiklik, gösterişli çiçek, hoş koku, tıbbi/aromatik kullanım, gölgeye dayanıklılık, çiçek parterinde kullanım, toprak toleransı, refüj kullanımı, su kenarı kullanımı, sergi/gösteri amaçlı kullanım ve kaya bahçelerinde kullanım gibi peyzaj açısından önemli bazı kriterler açısından değerlendirilmiştir. Çalışma sonucunda, Bingöl florasında yer alan 56 geofit taksonun peyzaj tasarımında yüksek potansiyele sahip olduğu belirlenmiştir. Bu taksonların ekolojik uyumları, düşük bakım gereksinimleri ve estetik özellikleri sayesinde sürdürülebilir peyzaj tasarımları için önemli bir alternatif kaynak oluşturabileceği düşünülmektedir. Elde edilen bulgular, doğal floradaki potansiyelin peyzaj planlama ve uygulamalarında daha etkin kullanılmasına katkı sağlamaktadır.

Anahtar kelimeler

Bingöl florası,
Geofit bitkiler,
Peyzaj tasarımı,
Sürdürülebilirlik,
Doğal bitki
kullanımı

1. INTRODUCTION

Turkey is a country situated on both the Asian and European continents; it is bordered by the Black Sea to the north, the Aegean Sea to the west, and the Mediterranean Sea to the south. Three main phytogeographic regions influence Turkey's geography: European-Siberian, Mediterranean, and Iran-Turan. The country has a wide variety of ecosystems, including coastal and marine areas, lakes, agricultural areas, mountains, forests, steppes and wetlands. The flora and fauna are extremely rich, with a high rate of endemism and significant genetic diversity [1]. Our country possesses a rich plant diversity due to its many different habitat types, its location at the intersection of three phytogeographical regions, its role in connecting the Asian and European continents, its ecological diversity and elevation gradient ranging from 0 to 5000 metres, as well as its abundant water resources [2]. Thanks to its rich flora, Turkey is a centre for many plant species and is home to over 12,000 plant species. Considering that there are over 3,700 endemic plant species in Turkey's flora, the level of biological diversity in the country becomes easier to understand [3].

Our country, which holds an important position in the world in terms of plant diversity, is also home to many geophyte species. Geophytes are perennial plants that have organs such as bulbs, tubers and rhizomes underground, spend unfavourable seasonal conditions underground in these organs, and bloom in early spring and autumn [4]. Geophyte (Geophyta) is a Latin word formed by combining 'geo,' meaning 'earth,' and 'phyta,' meaning 'plant,' and refers to 'earth plants, hidden plants' [5]. They are commonly known as onion, bulb, rhizome and corm plants [6].

The term 'geophyte' was first used by the Danish botanist Christian Raunki. Geophytes belong to the Magnoliophyta (angiosperms) group and constitute approximately 6.5-7% of the more than 250,000 species of flowering plants. Geophytes are found almost

everywhere in the world, with most of their origins in the Mediterranean basin [7]. Almost all of these plants are of economic and medicinal importance [7-8].

Geophytes have been used by humans for various economic purposes in the food, medicinal and industrial sectors from ancient times to the present day. Geophytes, which hold an important place in folk medicine, are used in the treatment of many diseases thanks to the active ingredients they contain. The underground organs of geophytes, such as rhizomes, bulbs and tubers, or their above-ground organs, such as fruits, leaves and stems, have been prepared by the public for centuries using various methods, such as infusion, decoction and poultice, for the treatment of many diseases [9]. Geophytes, which have many uses, are produced and traded worldwide. However, there are also geophyte species whose production and trade are not yet sufficiently developed worldwide, or for which no attempts have even been made [10].

Although there are numerous scientific studies on geophytes, the number of studies on the landscape potential of geophytes is quite limited.

This study aims to identify geophyte taxa that grow naturally in Bingöl province and are of economic importance due to their landscape potential. Furthermore, the study aims to provide scientifically based recommendations for the conservation and sustainable use of geophytes.

2. MATERIAL AND METHOD

Bingöl Province is located in the east of the Eastern Anatolia Region, between Erzincan, Erzurum, Muş, Diyarbakır, Elazığ and Tunceli (Figure 1). Situated within the Iran-Turan phytogeographic region, the province possesses a rich floristic structure characterised by elevation differences, topographic diversity and microclimatic features [11].

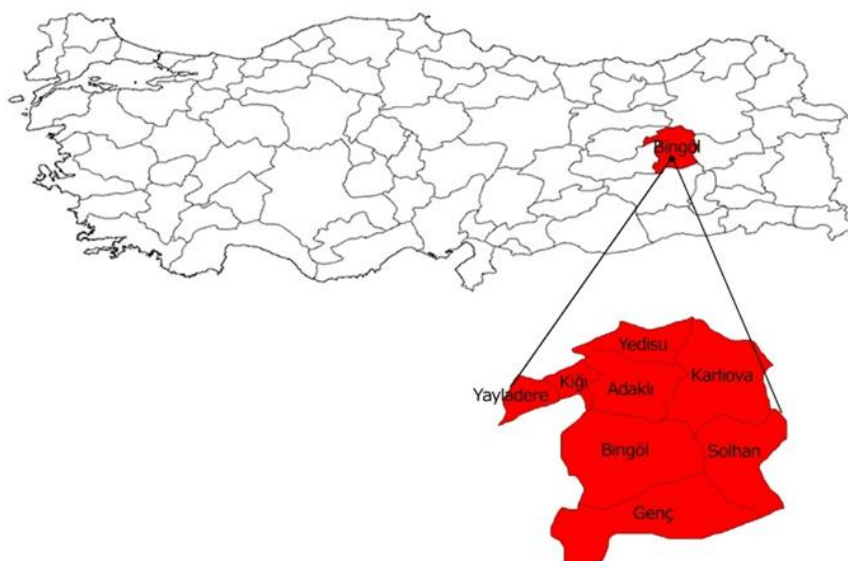


Figure 1. Location and districts of Bingöl province

2.1. Material

This research, conducted to determine the potential use of geophytic taxa naturally occurring in Bingöl province in landscape architecture applications and the ornamental plant sector, involves detailed fieldwork. Field studies were conducted in different geographical areas of Bingöl province. Geophytes naturally occurring in these regions were identified, and their local distribution and growing environments were determined.

Fieldwork was generally conducted between February and November during the period 2022-2024. Furthermore, data from previous studies on geophytes in the Bingöl region were evaluated as part of this work. During the collection of samples in the field studies, care was taken to collect parts essential for species identification, such as fruit, bulbs, seeds, flowers, and basal leaves, as appropriate to the families as far as possible. For this purpose, the plant was monitored and photographed throughout all its stages from spring to autumn over a period of two years. The 11-volume Flora of Turkey and the East Aegean Islands ([12], [13], [14]) was used for plant identification. Additionally, the Illustrated Flora of Turkey, Volumes 2 and 3 ([15], [16]), were consulted. The scientific names and authors of taxa are taken from WFO, The Plant List, Bizim Bitkiler and Türkiye Bitkileri Listesi (List of Plants of Turkey) Güner et al. [17], their Turkish names are also taken from the same source.

2.1.1. General characteristics of Bingöl province

Considering the climate, topography and soil characteristics of Bingöl Province, the province is located at the intersection of the North Anatolian Fault Zone (NAFZ) and the East Anatolian Fault Zone (EAFZ), with an average elevation of 1,745 metres. The elevation varies between 800 m and 3019 m. The average slope is 16.5°, with the southern slopes (%40.4) being steeper than the northern slopes (%33). Mountainous areas, plateaus, valleys and plains/basins constitute the main morphological units of the province. The tectonically formed Bingöl Plain, Karlıova, Yedisu and Sancak Basins have more moderate conditions than their surroundings. Due to the diversity of elevation and surface features in the province, where the continental climate is effective, climatic elements vary; temperature decreases and precipitation increases towards the north [18]. In Bingöl, where a harsh continental climate prevails, the average temperature in winter is -9 °C, while in summer it reaches +39 °C. Annual precipitation exceeds 900 mm, snowfall is abundant, and snow depth can reach 3–4 metres. The vegetation consists of forests, steppes and shrublands, with 15% of the area covered by forests and 70% by meadows and pastures [19]. In terms of soil characteristics, basaltic soils belonging to the intrazonal soil group in Bingöl have the widest spatial distribution at 35.2 per cent, and the parent rock has been decisive in their formation [18]. In terms of geological structure,

basalt and andesite are common in the Bingöl Mountains, and these young volcanic masses have covered the underlying sedimentary layers [19].

2.2. Method

A series of criteria have been established to evaluate the potential use of taxa in landscape design. These criteria are as follows: endemism, showy flowers (suitable for use in landscape architecture in terms of flower structure), pleasant fragrance, medicinal/aromatic use (having regional or medical applications), shade tolerance, use in flower beds, soil tolerance (ability to grow in sandy, loamy, or clay soils, in other words, not being soil-selective), use in refuges, use near water, use for exhibition/display purposes, and use in rock gardens [20]. These criteria have been used to assess how functional and aesthetically pleasing plant species can be in landscape design. The 11 criteria have been given equal weighting, and each criterion is scored as either 1 (present) or 0 (absent). The sum of the scores obtained from the criteria for each taxon forms a 'potential use score' between 0 and 11. Each geophyte species was evaluated separately according to the defined criteria, and those with 5 or more characteristics were considered taxa with high potential for use in landscape design.

3. RESULTS

The study data were collected through numerous field studies conducted between 2022 and 2024. The study was conducted on randomly selected sample plots in areas where geophyte taxa naturally occur in Bingöl and its surroundings. Additionally, previous studies in the research area include Flora of Altıkardeş Mountain and its Surroundings (Genç/Bingöl) [21], Flora of Hiro Plateau and its Surroundings (Adaklı-Bingöl/Turkey) [23], Pollen Atlas of Bingöl Bee Flora [24], Flora of Koz Mountain (Genç/Bingöl) and its Surroundings [25], Flora of Genç District (Bingöl) and its Vicinity [26], and Flora of Perisuyu Valley and its Vicinity (Yedisu-Karlıova/Bingöl) [27], it was determined that 150 geophyte taxa are naturally distributed in the area.

The study revealed that the 150 taxa identified are distributed across different families. The Amaryllidaceae family comprises the highest number of taxa, with 32 taxa accounting for approximately 21.3% of the total. This is followed by the Orchidaceae family with 30 taxa (20.0%), the Liliaceae family with 27 taxa (18.0%), and the Asparagaceae family with 23 taxa (15.3%). The Iridaceae family accounts for 11.3% of the total with 17 taxa. Among the families with a moderate number of taxa, the Ranunculaceae family is represented by 7 taxa, while the Colchicaceae family includes 4 taxa. Looking at the families represented by fewer taxa, the Poaceae and Ixioliriaceae families each contain 2 taxa. The Asphodelaceae, Araceae, Geraniaceae, Paeoniaceae, Papaveraceae, and Xanthorrhoeaceae families are each represented by 1 taxon in the field (Figure 2).

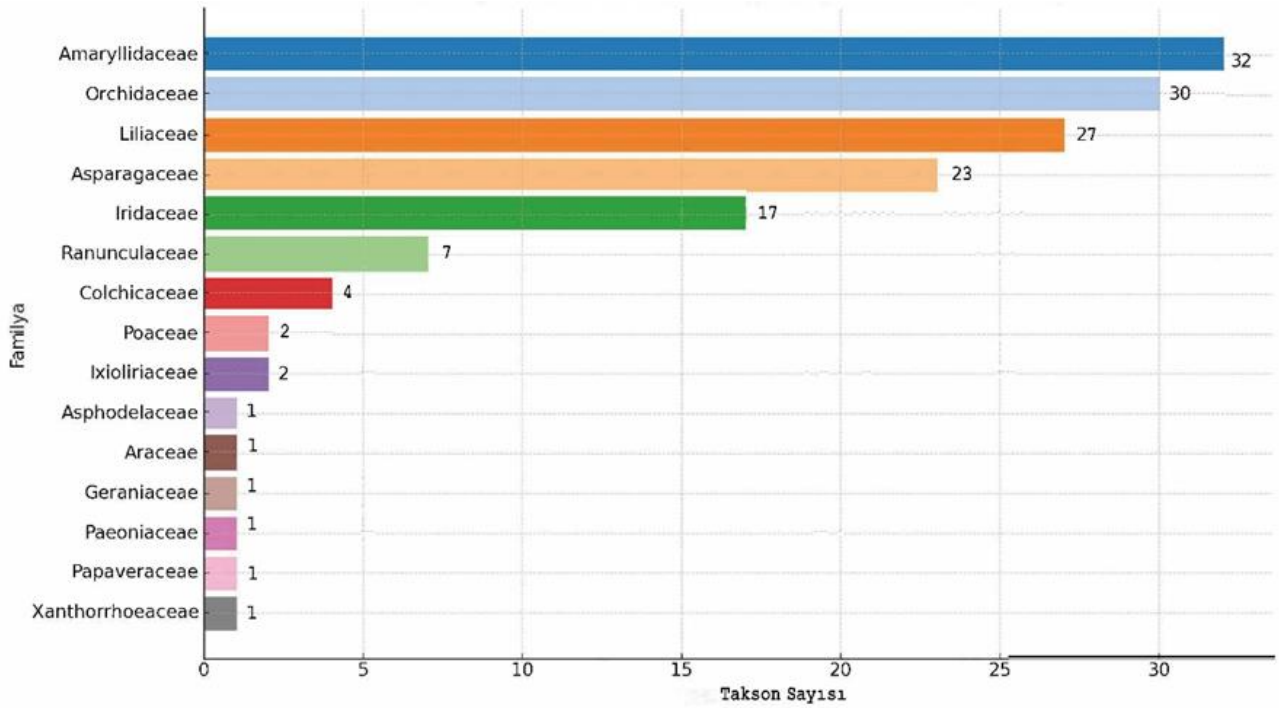


Figure 2. Distribution of taxa according to family

A total of 150 geophyte taxa were analysed for their potential suitability for use in landscape design according to the specified evaluation criteria. The evaluations revealed that 56 taxa exhibited characteristics suitable for use in landscape design. These taxa scored 5 or more points on the evaluation criteria and are therefore classified as having high landscape potential. Of the 56 taxa in question, 8 are endemic, 54 have showy flowers, 5 are pleasant fragrance, and 9 have medicinal-aromatic value. Additionally, 7 taxa have been determined to be

shade-tolerant, and 46 are tolerant to different soil types. It has been determined that 52 of these taxa are suitable for use in flower beds, 26 in refuge areas, 4 in waterside landscapes, and 54 for exhibition purposes and rock gardens. These data show that geophyte taxa have a wide range of potential uses in different landscape design components. Detailed findings are presented in Table 1.

Table 1. Assessment of naturally occurring geophyte species in Bingöl province for their potential use in landscape architecture

Family	Latin Name	Turkish Name	Endemism	Showy Flower	Pleasant Fragrance	Medicinal/Aromatic Use	Shade Tolerance	Use In Flower Beds	Soil Tolerance	Use In Refuges	Use Near Water	Use For Exhibition/Display Purposes	Use In Rock Gardens	Score
Amaryllidaceae	<i>Allium akaka</i> S.G.Gmel. ex Schult. & Schult.f.	Yer Soğanı		x		x		x	x			x	x	6
Amaryllidaceae	<i>Allium armenum</i> Boiss. & Kotschy	Pembe Sırım	x	x		x		x	x			x	x	7
Amaryllidaceae	<i>Allium tripedale</i> Trautv.	Şah Sarmısağı		x				x	x			x	x	5
Amaryllidaceae	<i>Allium tuncelianum</i> (Kollmann) Özhatay, B.Mathew & Şiraneci	Tunceli Sarmısağı	x	x				x	x			x	x	6
Amaryllidaceae	<i>Sternbergia clusiana</i> (Ker Gawl.) Ker Gawl. ex Spreng.	Vargetgülü		x				x	x			x	x	5
Araceae	<i>Arum rupicola</i> var. <i>rupicola</i> Boiss.	Dağsorsalı		x			x	x		x	x		x	6
Asparagaceae	<i>Bellevalia paradoxa</i> (Fisch. & C.A.Mey.) Boiss.	Aşpenceri		x				x	x	x		x		5
Asparagaceae	<i>Bellevalia speciosa</i> Woronow ex Gross.	Saplı Sümbül		x				x	x			x	x	5
Asparagaceae	<i>Hyacinthus orientalis</i> L.	Sümbül		x	x			x				x	x	5
Asparagaceae	<i>Muscari armeniacum</i> Leichtlin ex Baker	Gâvurbaşı		x				x	x			x	x	5

Family	Latin Name	Turkish Name	Endemism	Showy Flower	Pleasant Fragrance	Medicinal/Aromatic Use	Shade Tolerance	Use In Flower Beds	Soil Tolerance	Use In Refuges	Use Near Water	Use For Exhibition/Display Purposes	Use In Rock Gardens	Score
Asparagaceae	<i>Muscari azureum</i> Fenzl	Keşişbaşı		x				x	x			x	x	5
Asparagaceae	<i>Ornithogalum narbonense</i> L.	Akbaldır		x					x	x		x	x	5
Asparagaceae	<i>Ornithogalum wiedemannii</i> Boiss. var. <i>wiedemannii</i>	Engin Yıldız		x				x	x			x	x	5
Asparagaceae	<i>Puschkinia scilloides</i> Adams.	Serhişing		x				x	x		x	x	x	6
Asparagaceae	<i>Scilla leepii</i> Speta	İnce Sümbül	x						x		x	x	x	5
Asparagaceae	<i>Scilla siberica</i> Haw.	Camışkırın		x				x	x		x	x	x	6
Colchicaceae	<i>Colchicum falcifolium</i> Stapf	Domuz Çiğdemi						x	x	x		x	x	5
Colchicaceae	<i>Colchicum kotschyi</i> Boiss.	Acıçiğdem		x		x		x	x	x		x	x	7
Colchicaceae	<i>Colchicum szovitsii</i> Fisch. & C.A.Mey.	Katr Çiğdemi		x			x	x	x	x		x	x	7
Geraniaceae	<i>Geranium tuberosum</i> L.	Çakmuz		x		x	x	x	x	x		x	x	8
Iridaceae	<i>Crocus biflorus</i> Mill. subsp. <i>adamii</i> (Gay) B.Mathew	Çökülce		x				x	x	x		x	x	6
Iridaceae	<i>Crocus pallasii</i> Goldb.	Güzçimi		x				x	x	x		x	x	6
Iridaceae	<i>Crocus speciosus</i> M.Bieb.	Çayır Çiğdemi		x				x	x	x		x	x	6
Iridaceae	<i>Gladiolus humilis</i> Stapf	Bodur Kılıçotu	x						x	x		x	x	5
Iridaceae	<i>Gladiolus kotschyanus</i> Boiss.	Çayır Kılıçotu		x				x	x			x	x	5
Iridaceae	<i>Iris caucasica</i> Hoffm. subsp. <i>caucasica</i>	Kaf Navruz		x				x	x	x		x	x	6
Iridaceae	<i>Iris caucasica</i> Hoffm. subsp. <i>turcica</i> B.Mathew	Türk Navruz		x				x	x	x		x	x	6
Iridaceae	<i>Iris reticulata</i> M.Bieb. var. <i>reticulata</i>	Kara Körpeze		x			x	x	x	x		x	x	7
Iridaceae	<i>Iris pseudocaucaucasica</i> Grossh.	Van Navruz		x				x	x	x		x	x	6
Iridaceae	<i>Iris sari</i> Schott ex Baker	Ana Kurtkulağı	x	x				x	x	x		x	x	7
Ixioliriaceae	<i>Ixiolirion tataricum</i> var. <i>tataricum</i> (Pall.) Schult. & Schult.f.	Köpekotu		x				x	x	x		x	x	6
Liliaceae	<i>Fritillaria alburyana</i> Rix	Pembel lâle	x	x				x	x	x		x	x	7
Liliaceae	<i>Fritillaria armena</i> Boiss.			x				x	x	x		x	x	6
Liliaceae	<i>Fritillaria assyriaca</i> Baker subsp. <i>melananthera</i> Rix	Mut Lâlesi	x	x				x	x	x		x	x	8
Liliaceae	<i>Fritillaria caucasica</i> Adam	Kaf Lâlesi		x				x	x	x		x	x	6
Liliaceae	<i>Fritillaria pinardii</i> Boiss.	Mağçup Lâle		x				x	x	x		x	x	6
Liliaceae	<i>Fritillaria imperialis</i> L.	Ağlayangelin		x				x	x	x		x	x	6
Liliaceae	<i>Fritillaria persica</i> L.	Kırk Lâle		x				x	x			x	x	5
Liliaceae	<i>Gagea bohemica</i> (Zauschn.) Schult. & Schult.f.	Sarıyıldız		x			x	x	x				x	5
Liliaceae	<i>Gagea reticulata</i> (Pall.) Schult. & Schult.f.	Ağ Yıldızı		x			x	x	x				x	5
Liliaceae	<i>Tulipa armena</i> Boiss. var. <i>armena</i>	Dağ Lâlesi		x	x				x			x	x	5
Liliaceae	<i>Tulipa armena</i> Boiss. var. <i>galatica</i> (Freyn) Eker	Altın Lâle		x	x			x	x			x	x	6
Liliaceae	<i>Tulipa humilis</i> Herb.	Çoban Lâlesi		x	x				x			x	x	5
Liliaceae	<i>Tulipa sintenisii</i> Baker	Muş Lâlesi	x	x				x	x			x	x	5
Orchidaceae	<i>Dactylorhiza osmanica</i> (Klinge) P.F.Hunt & Summerh. var. <i>osmanica</i>	Osmanlı Salebi	x	x		x		x				x		5

Family	Latin Name	Turkish Name	Endemism	Showy Flower	Pleasant Fragrance	Medicinal/Aromatic Use	Shade Tolerance	Use In Flower Beds	Soil Tolerance	Use In Refuges	Use Near Water	Use For Exhibition/Display Purposes	Use In Rock Gardens	Score
Orchidaceae	<i>Himantoglossum comperianum</i> (Steven) P.Delforge	Meşe Keşkeşi		x				x		x		x	x	5
Orchidaceae	<i>Orchis palustris</i> Jacq.	Çayır Salebi		x		x		x				x	x	5
Orchidaceae	<i>Orchis punctulata</i> Steven ex Lindley	Selef		x		x		x				x	x	5
Orchidaceae	<i>Orchis purpurea</i> Huds.	Hasancık		x		x		x				x	x	5
Orchidaceae	<i>Orchis tridentata</i> Scop.	Katranalacası		x		x		x				x	x	5
Paeoniaceae	<i>Paeonia arietina</i> G.Anderson	Şakayık		x	x			x				x	x	5
Papaveraceae	<i>Corydalis oppositifolia</i> subsp. <i>kurdica</i> (Cullen & P.H.Davis) Lidén	Şepirze		x			x	x				x	x	5
Poaceae	<i>Poa bulbosa</i> L.	Yumrulu Salkım		x				x	x	x		x		5
Ranunculaceae	<i>Ranunculus illyricus</i> L.	Gümüş Dügünçeği		x				x	x			x	x	5
Ranunculaceae	<i>Ranunculus heterorrhizus</i> Boiss. & Balansa	Rubiçiçeği		x				x	x			x	x	5
Xanthorrhoeaceae	<i>Eremurus spectabilis</i> M. Bieb	Çiriş		x				x	x	x		x	x	6

Figures 3 and 4 show geophyte taxa that grow naturally in Bingöl province and have high potential for use in landscape design.

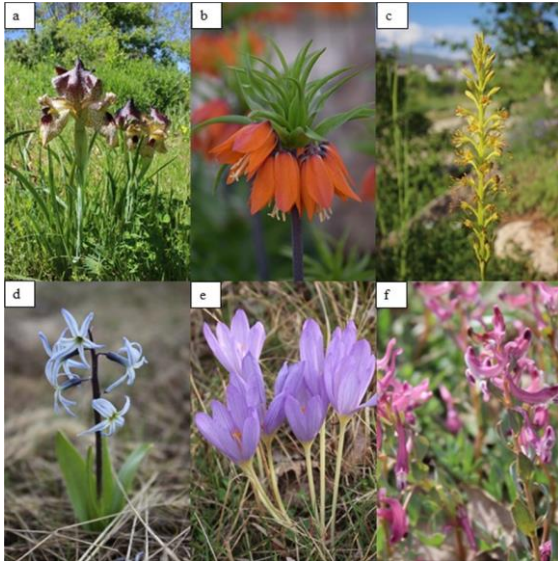


Figure 3. a: *Iris sari*, b: *Fritillaria imperialis*, c: *Eremurus spectabilis*, d: *Hyacinthus orientalis*, e: *Crocus speciosus*, f: *Corydalis oppositifolia* subsp. *kurdica*



Figure 4. g: *Fritillaria pinardii*, h: *Colchicum szovitsii*, i: *Geranium tuberosum*, j: *Paeonia arietina*, k: *Iris reticulata*, l: *Himantoglossum comperianum*

4. DISCUSSION AND CONCLUSION

A review of the literature reveals that studies on geophytes in Bingöl Province and its surroundings are very limited in number. The floristic studies conducted within the province boundaries, which partially investigated geophyte taxa, mostly covered specific plateau and mountain areas. Among these studies are: Altıkardaş Mountain and its surroundings (Genç, Bingöl) [21], the surroundings of Yüzenadalar (Bingöl-Solhan) [22], Hiro Plateau (Adaklı-Bingöl) and its surroundings [23], the Bingöl Bee Flora Pollen Atlas [24], Koz Mountain and its surroundings (Genç/Bingöl) [25], Genç District and its immediate surroundings [26], and Perisuyu Valley and its surroundings (Yedisu-Karlıova) [27].

In a study conducted by Caf et al. [28], woody plants used in open green areas in Bingöl province and its surroundings were investigated. This study determined that a total of 90 woody plant taxa were used for various purposes in open and green areas in Bingöl city, and that 18 of these taxa were native to the region. Ahıskalı and Canlı [29] identified 200 taxa in a study conducted to reveal the flora of Bingöl University Campus. They stated that 97 of these taxa were used for landscaping purposes. Previous studies have focused on woody plants used in landscaping in Bingöl and its surroundings and on the flora of the university campus, indicating that a certain number of species could be used for landscaping purposes [28,29]. This study, however, evaluated the natural geophyte species in the region and revealed that 56 taxa have high potential for use in landscape design, thus demonstrating that a sustainable landscape resource can be provided from the region's natural flora.

Various studies have been conducted on geophytes in different regions of Turkey. Kılıçaslan and Dönmez [20] evaluated floristic studies conducted in the lake region (encompassing 65 lakes of varying sizes, bounded by Lake Beyşehir in the east, Lake Acı and Lake Solda in the west, Lake Eber in the north, and the Gülük and Köprülü passes in the south) and determined that 191 bulbous plant taxa were distributed in the field. In their work, they also developed a flowering calendar and proposed bulbous plant gardens that can remain in bloom throughout the year for use in botanical design applications. The study revealed that some taxa identified as having “high landscape use criteria”, such as *Muscari armeniacum*, *Ornithogalum narbonense*, *Colchicum kotschyi*, *Colchicum szovitsii*, *Orchis tridentata*, etc., are common to the Bingöl region's landscape potential geophytes study. In a study conducted by Avcu et al. [30] in the Bayramiç region of Çanakkale, 54 taxa belonging to 16 families and 36 genera were identified. Eight of these taxa are endemic to Turkey. In a study conducted by Babacan and Eker [31] between 2012 and 2013 to identify the geophyte flora in the Munzur Valley of Tunceli Province, 48 genera belonging to 22 families and 113 taxa were identified. Fourteen of these are endemic and 6 are rare. In a geophyte study conducted by Öz and Akan [32] in the districts of Dalaman and Ortaca in Muğla Province, 84 geophyte taxa belonging to 38 genera in 13 families were recorded. Erduran Nemutlu and Çanga [33] selected 30 geophyte taxa and created a table and template that could facilitate the selection of the most suitable species according to ecological conditions. It was emphasised that the selected geophytes were species suitable for growth under Turkish climatic conditions and exhibiting aesthetic characteristics for use in landscape architecture projects. In a study conducted in Mersin province by Topal et al. [34], 256 different geophyte taxa belonging to 23 families and 68 genera were identified. The study emphasised that the identification and promotion of these plants is important for the conservation and sustainability of biological diversity. In a study conducted by Balos et al. [35] to identify the geophyte flora distributed within the borders of Mardin province, 167 taxa belonging to 30 families and 64 genera were identified.

Due to the effects of global warming, the amount of fresh water on Earth is rapidly decreasing. Therefore, it is crucial to use geophytes, which have more limited water requirements, in landscaping. It is particularly important to evaluate geophytes, which are part of the naturally occurring local flora, in landscaping in terms of economic value and sustainability.

Bulbous plants require very little watering. Therefore, the use of naturally growing bulbous plants is important both aesthetically and ecologically in terms of drought-tolerant landscaping [20].

Field studies and literature reviews have identified 150 geophyte taxa in Bingöl and its surroundings, of which 56 have been determined to have higher potential for use in landscape design. The findings indicate that local geophyte species could serve as an important alternative resource for aesthetically, ecologically, and economically sustainable landscape designs.

In landscaping applications, municipalities should prefer geophyte species that occur naturally in the regional flora instead of imported plant material. This will contribute to ensuring ecological adaptation, reducing maintenance costs, and preserving biological diversity. In this context, taxa such as *Hyacinthus orientalis* L., *Tulipa armena* Boiss., *Tulipa humilis* Herb, and *Paeonia arietina* G. Anderson stand out in terms of landscape aesthetics with their showy flowers and pleasant fragrance.

From the perspective of wetland landscape, taxa such as *Hyacinthus orientalis* L., *Puschkinia scilloides* Adams, *Scilla leepii* Speta, and *Scilla siberica* Haw. are seen to hold significant potential. Furthermore, the fact that many of the geophytic taxa included in the study are tolerant to arid conditions indicates that these plants offer valuable potential for sustainable landscape applications that are adaptable to climate change.

Nevertheless, species such as *Allium akaka* S.G. Gmel. ex Schult. & Schult.f., *Allium armenum* Boiss. & Kotschy, *Colchicum kotschyi* Boiss., *Geranium tuberosum* L., *Dactylorhiza osmanica* (Klinge) P.F. Hunt & Summerh., *Orchis palustris* Jacq., *Orchis punctulata* Steven ex Lindl., *Orchis purpurea* Huds., and *Orchis tridentata* Scop. have also been identified as possessing commercial production potential owing to their medicinal and aromatic properties.

In the overall assessment, the taxa with the highest scores in terms of landscape potential evaluation criteria were *Allium armenum* Boiss. & Kotschy, *Colchicum kotschyi* Boiss., *Colchicum szovitsii* Fisch. & C.A. Mey., *Fritillaria assyriaca* Baker, *Fritillaria alburyana* Rix, *Geranium tuberosum* L., *Iris reticulata* M.Bieb., and *Iris sari* Schott ex Baker. As these taxa are an important part of the local flora and are also suitable for the region's climate data, their use in landscape design in the area is recommended.

This study on the potential use of geophyte species found in Bingöl in landscape design contributes significantly to the evaluation of the region's natural vegetation cover from a landscape architecture perspective. Encouraging the use of these species in landscape design will both help preserve local plant diversity and enable the creation of aesthetically and functionally rich landscape areas. The findings of the study show that there are various geophyte species that can be used in landscape design in Bingöl and that these species can be evaluated for different design purposes in flower beds, refuges, waterside areas, shaded areas, and ornamental gardens. In particular, the use of local taxa in urban landscapes will significantly contribute to emphasising the region's unique identity and preserving biodiversity.

It is crucial that local authorities and relevant institutions recognise this wealth in the region and contribute to the promotion of geophyte species. Regulations should be put in place to encourage the use of natural flora in landscape projects at specific rates. Developing the production and supply chain of geophyte species will ensure that these taxa are recognised, more readily available for landscape projects, and can be used effectively.

The potential for using geophytic taxa found in Bingöl province in landscape design is quite high. Many of these species attract attention with their showy flowers, pleasant fragrances, and medicinal/aromatic properties. The study shows that geophytic species in Bingöl province have the potential to be used in landscape design and ornamental plant applications, as many of these species are adapted to the local soil, climate, and light conditions, suggesting they could thrive in urban green spaces with low maintenance requirements. These species also have potential for use in landscape design in other regions influenced by the Iran-Turan phytogeographical region, which spans a large area of the country.

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