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Determining User Preferences for some Natural Astragalus Species distributed in Ankara

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Abstract
This study applied a photograph-based survey to 130 participants to determine user preferences for 21 different Astragalus taxa with various characteristics distributed in Ankara. A total of 63 images likes were collected and the photographs were categorized. Three different categories were obtained in the confirmatory factor analysis. The differences between the averages of these categories were compared with the one-way ANOVA test, revealing a significant difference between the three categories. As a result, *Astragalus anthylloides* was identified as the most preferred species.

Keywords: *Astragalus*; milkvetch; Landscape Architecture; Ankara

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1.0 Introduction

Considering the effects of climate change that can be observed in landscapes today and are expected to increase in the coming years, the concept of 'sustainability,' along with the efficient and effective use of resources, emphasizes the use of natural plant species, which are vegetative landscape elements that contribute to sustainability. Despite the richness of natural plant species in Turkey, it can be seen that only some of these species are used in landscape architecture. In contrast, foreign species are predominantly used in various rural and urban landscape projects. The predominant use of foreign species in rural and urban landscape planting projects in areas with different characteristics increases the demand for water, nutrients, labor, and time and causes many economic and ecological problems.

In order to contribute to the solution of these problems and to promote the efficient use of resources, The object of the study is to determine the most demanded species among the *astragalus* species under investigation. This study aims to investigate their preferences, and by understanding their degree of liking, awareness can be raised about their use in landscape architecture and commercial cultivation. This study has been carried out on the basis of some data obtained in the framework of the Ph.D. thesis entitled "Determination of the Utilization Potential of Some Astragalus Species Spread Around Ankara Province in Landscape Architecture Studies," which was carried out at the Faculty of Landscape Architecture, Ankara University.

Astragalus is a genus that attracts attention due to its wide variety of species worldwide and in our country. Astragalus, which belongs to the Fabaceae family, is recognized worldwide as having 3239 species, 318 varieties, and 183 subspecies (https://wfoplantlist.org). Astragalus has the most species among the natural plant vegetation in Turkey (Kışoğlu, 2018). Among our

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natural plant species, Astragalus sp. has attracted attention with its many species. As a result of new records and publications and the addition of new species, the number of Astragalus species has reached 490. (Aytaç et al., 2012; Özhatay et al., 2013; 2017; 2019; Aytaç et al., 2021). In terms of endemic taxa, according to the study of Astragalus taxa based on the geographical regions of Turkey, the Central Anatolia region holds the highest rank with 100 taxa, a rate of 29.1% of the total (Başbağ et al., 2018). The province of Ankara is home to a diverse range of Astragalus species, with a wide distribution across different geographical features. This significant diversity includes 86 taxa, including 33 endemic species, with different morphologies and characters (Eker et al., 2015). Species belonging to the Astragalus genus are low plants that can be annual or perennial, with thorny or thornless herbaceous or woody forms (Aytaç et al., 2012; Özhatay et al., 2013, 2017, 2019; Bilgi, 2023). Astragalus species, which spread in soils of all types with their strong roots, have a significant feature in soil conservation and erosion prevention (Şen, 2020).

2.0 Literature Review

Since almost half of the species subject to the study are endemic, we focused on studies conducted in Turkey. Studies have yet to be conducted in any field concerning the *astragalus* species under scrutiny, nor have the user demands for these species been assessed. In addition, there are few related studies. Studies conducted in the Department of Landscape Architecture on the use of the genus Astragalus or in which there is no study to determine the demand for flora or natural plant species are:

In the study conducted by Erbil (2021), the endemic Astragalus vulnerariae DC., which is naturally distributed in Konya and its surroundings, was produced with cuttings in a semi-controlled greenhouse. Its morphological characteristics were determined, and its usage areas in landscape studies were determined. Temel (2018) is surveyed to determine user preferences for natural plant species that do not include *astragalus* species. Dilaver (2010) studied the usability of *Astragalus angustifolius subsp. pungens, Astragalus anthylloides*, and *Astragalus densifolius subsp. ayashensis* species in landscape architecture studies.

Astragalus species have the potential to be used in landscape architecture due to their aesthetic and functional properties. However, the main reasons for their exclusion from application areas include the need for more awareness and information about the demand for the species. This lack of awareness affects the preference for use, as there is insufficient recognition and knowledge of the potential for use. In the field of landscape architecture in Turkey, the number of studies on Astragalus and its species is minimal, and more information is needed on the use of endemic species. The lack of detailed studies prevents the complete evaluation of this potential.

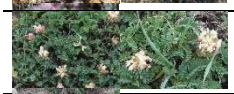
3.0 Methodology

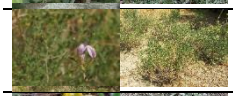
The study covers areas within the borders of Ankara province, including the city center, central districts, and provinces. Ankara province covers an area of 26,897 km2 and has an altitude of 890 meters above sea level (ktb.gov.tr). Although it contains many areas of different character, it has different climatic characteristics in different seasons and has a continental steppe climate. Summers are hot and dry, while winters are cold.

The species were photographed in many different areas. Considering the extensive geographical region of Ankara province, the scarcity of the species spring flowering period, and the logistical difficulties associated with transport, it has been deemed appropriate to spread land studies over the years. As part of this research, 21 Astragalus taxa documented and photographed during the first year of fieldwork were examined. These taxa were found in various configurations throughout the provincial districts. A total of 9 taxa are recognized as endemic, with three of them categorized as locally endemic. Of the observed taxa, 10 exhibit a shrub, while 11 exhibit herbaceous characteristics, and all of them are perennial plants. Furthermore, seven of the taxa exhibit thorny attributes, while 14 lack thorns (Table 1).

In order to determine user preferences for the taxa under study, a face-to-face questionnaire was administered to 130 participants at the Lodumlu Central Campus of the Ministry of Agriculture and Forestry in Ankara, where the corresponding author works, by projecting the images on a computer or projector. An ordinal Likert scale was used under each image, ranging from "I do not like" to 1,2,3,4,5 and "I like it." It is important to note that the visual stimuli were randomly presented to mitigate potential bias and ensure an impartial presentation sequence. As a result, three distinct images were selected for each taxon, leading to a comprehensive compilation of 63 images for which participant preferences were documented.

Table 1 Plant species included in the survey

	Photo no in a survey	Taxa Name	Shrub	Herbaceous	Thorny	Thornless	Endemic	Nonendemic
	6,23,38	*Astragalus acicularis Bunge*	•		•		•	
	9,19,48	*Astragalus amoenus Fenzl*	•			•	•	
	21,50,61	*Astragalus angustifolius Lam. subsp. pungens (Willd.)*	•		•			•

	28,43,55	*Astragalus anthylloides Lam.*		●		●		●
	14,25,41	*Astragalus baibutensis Bunge*	●		●		●	
	2,15,39	*Astragalus beypazaricus Podlech & Aytaç*		●		●	●	
	30,46,56	*Astragalus bozakmanii Podlech*		●		●	●	
	3,20,34	*Astragalus christianus*		●		●		●
	32,42,60	*Astragalus densifolius Lam. subsp. Densifolius*		●		●		●
	5,26,54	*Astragalus densifolius Lam. subsp. Ayashensis Aytaç & Ekim*		●		●	●	
	1,10,31	*Astragalus microcephalus*	●		●			●
	8,12,33	*Astragalus mesogitanus*		●		●	●	
	18,47,62	*Astragalus nanus DC*		●		●		●
	16,51,58	*Astragalus odoratus Lam.*	●			●		●
	13,44,59	*Astragalus ovalis Boiss. & Balansa*		●		●	●	
	4,11,27	*Astragalus pinetorum*		●		●		●
	24,40,53	*Astragalus plumosus*	●		●			●
	7,22,36	*Astragalus strictifolius Boiss. var. Kutepovii*	●		●			●
	17,35,49	*Astragalus vulnerariae DC.*	●			●	●	
	29,45,63	*Astragalus xylobasis Raw*		●		●		●
	37,52,57	*Astragalus wiedemannianus Fisch.*	●		●			●

4.0 Findings

4.1 Analysis of Participant Likes

Following the collection of user liking scores for 63 images through a photo-based survey, a reliability test was carried out on the responses to these 63 variables. The Cronbach Alpha Score of 0.957 on the 63 variables indicated strong reliability in the questionnaire responses. Subsequent exploratory factor analysis on the 63 variables revealed their clustering into 16 factors with Eigen values exceeding 1. However, considering that 16 factors do not align to explain more variables with fewer hypothetical constructs, a scree plot

curve analysis in Figure 1 identified a 3-factor structure (Figure 1). Therefore, the study focused on conducting confirmatory factor analyses centered on these three factors for the study's objectives (Table 2).

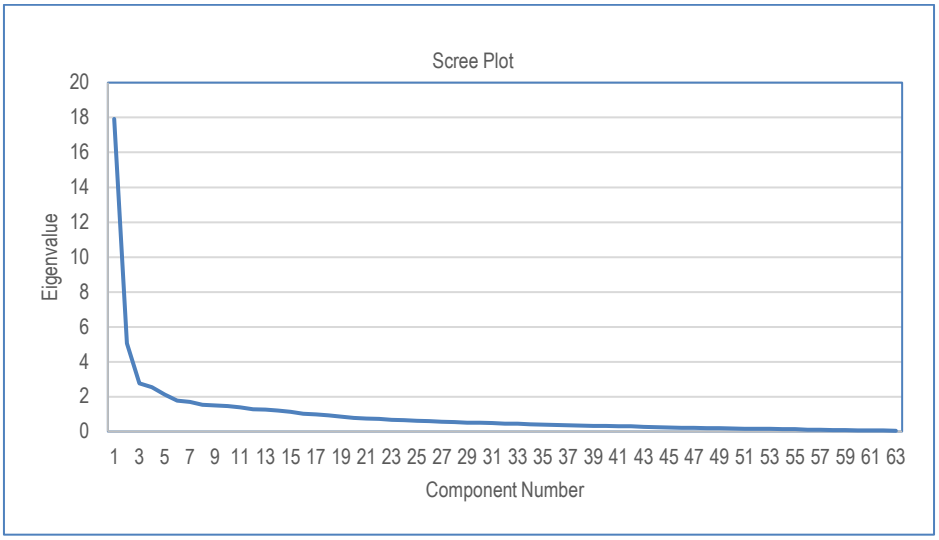


Fig 1. Eigenvalue scree plot

Furthermore, a 3-factor exploratory factor analysis was conducted, where variables 5, 18, 29, 31, 35, 36, and 61 of the photographs were excluded due to factor loadings below 0.45. Subsequently, a new exploratory factor analysis was carried out following the identification of low factor load values (below 0.45) for Photos 1, 2, 4, 21, 26, 28, 34, 40, 50, 62, and 63, and also for Photos 3 and 11 in a subsequent analysis. Additionally, the fourth exploratory factor was disregarded due to photo 10's low factor load (below 0.45), with factor load values falling under 0.48 being recorded to prevent double loads. Analyses yielding a 3-factor structure from confirmative factor analysis are presented in the table below, with the first factor comprising 24 components, the second factor comprising 13 components, and the third factor containing five components. This analysis enables the determination of which factors are more preferred and the significant differences in likes across factors.

Table 2. 3-factor exploratory factor analysis

Photo number in the survey	Specie name	Factor 1	Factor 2	Factor 3
33	*Astragalus mesogitanus*	0.804		
39	*Astragalus beypazaricus Podlech & Ayt*	0.751		
42	*Astragalus densifolius Lam. subsp. densifolius*	0.742		
57	*Astragalus wiedemannianus Fisch*	0.740		
59	*Astragalus ovalis Boiss. & Balansa*	0.740		
41	*Astragalus baibutensis Bunge*	0.704		
30	*Astragalus bozakmanii Podlech*	0.687		
51	*Astragalus odoratus Lam.*	0.679		
32	*Astragalus densifolius Lam. subsp. densifolius*	0.651		
37	*Astragalus wiedemannianus Fisch.*	0.627		
47	*Astragalus nanus DC*	0.627		
58	*Astragalus odoratus Lam.*	0.621		
54	*Astragalus densifolius Lam. subsp. ayashensis Aytaç & Ekim*	0.621		
13	*Astragalus ovalis Boiss. & Balansa*	0.599		
15	*Astragalus beypazaricus Podlech & Aytaç*	0.583		
60	*Astragalus densifolius Lam. subsp. densifolius*	0.571		
53	*Astragalus plumosus*	0.566		
44	*Astragalus ovalis Boiss. & Balansa*	0.555		
14	*Astragalus baibutensis Bunge*	0.553		
52	*Astragalus wiedemannianus Fisch.*	0.542		

22	*Astragalus strictifolius Boiss. var. Kutepovii*	0.533			
27	*Astragalus pinetorum*	0.519			
46	*Astragalus bozakmanii Podlech*	0.514			
48	*Astragalus amoenus Fenzl*	0.482			
25	*Astragalus baibutensis Bunge*		0.691		
24	*Astragalus plumosus*		0.683		
38	*Astragalus acicularis*		0.671		
17	*Astragalus vulnerariae DC*		0.660		
23	*Astragalus acicularis Bunge*		0.641		
20	*Astragalus christianus*		0.640		
55	*Astragalus anthylloides Lam.*		0.634		
43	*Astragalus anthylloides Lam*		0.624		
19	*Astragalus amoenus Fenzl*		0.594		
16	*Astragalus odoratus Lam.*		0.576		
56	*Astragalus bozakmanii Podlech*		0.569		
45	*Astragalus xylobasis Rawi*		0.542		
49	*Astragalus vulnerariae DC.*		0.513		
8	*Astragalus mesogitanus*			0.676	
7	*Astragalus strictifolius Boiss. var. Kutepovii*			0.645	
12	*Astragalus mesogitanus*			0.595	
6	*Astragalus acicularis Bunge*			0.553	
9	*Astragalus amoenus Fenzl*			0.543	

Table 3. Comparison of preferences for factors

Variable	Factor	N	Average	Std. Deviation	sd	F value	P value
Preference of Respondents	Factor 1	24	2,88[b]	0,47	2-39	51,141	0,000
	Factor 2	13	4,34[a]	0,20			
	Factor 3	5	3,20[b]	0,60			

[a b c] Groups formed based on Scheffe's method, with group "a" indicating the highest preference level.
(Source: Author)

Based on the analysis of liking scores among the factors, it has been determined that Factor 2 is the most liked factor among the three factors analyzed (Table 3). This factor stands out and is specialized, particularly in photographs captured during the plants' flowering periods. The analysis also indicates a significant difference between the factors in terms of liking ($F(2\text{-}39)= 51.141$, $P<0.01$). As a result, factor 2 emerged as the most liked group, whereas Factor 1 received the least liked factor with an average of 2.88. In this context, while it was considered appropriate to make species selections from factor 2, it was deemed appropriate to perform a one-way ANOVA analysis in order to see the ranking and grouping in factor 2 more clearly.

Table 4. Factor 2 one-way ANOVA analysis

Variable		Factor 2	N	Average	Std. Deviation	sd	F value	P value
Preference of Respondents		Photo 16	130	4.19 [abc]	0.808	16-1677	8,497	0,000
		Photo 17	130	4.52 [ab]	0.661			
		Photo 19	130	3.97 [c]	0.906			
		Photo 20	130	4.16 [bc]	0.824			
		Photo 23	130	4.45 [ab]	0.716			
		Photo 24	130	4.48 [ab]	0.685			

	Photo 25	130	4.25 abc	0.836
	Photo 38	130	4.29 abc	0.741
	Photo 43	130	4.15 bc	0.890
	Photo 45	130	4.53 ab	0.684
	Photo 49	130	4.29 abc	0.867
	Photo 55	130	4.62a	0.615
	Photo 56	130	4.55ab	0.695

an a, ab, abc, bc, c, Groups formed based on Scheffe's method, with the group "a" indicating the highest level of preference.

As a result of the analysis, it is seen that there is a significant change within Factor 2, according to Scheffe's test (Table 4). it is observed that 13 different photographs are grouped under the groups a, ab, abc, bc, and c where f (16-1677) = 8.497, p <0.001. Accordingly, it was determined through the analysis applied to the survey that the most liked photograph, Photo 55, which forms the group a Scheffe on its own and is seen in (Figure 2), ranks first in terms of the demand direction of the nonendemic *Astragalus anthylloides* Lam., highlighting the possibilities of using this species in landscape architecture and the necessity of creating awareness. Following this, photo 56 *Astragalus bozakmanii* Podlech, photo 45 *Astragalus xylobasis* Rawi, photo 17 *Astragalus vulnerariae* DC., photo 24 *Astragalus plumosus*, photo *23 Astragalus acicularis* Bunge, photo 25 *Astragalus baibutensis Bunge*, photo 16 *Astragalus odoratus*, photo 20 *Astragalus christianus,* and lastly *Astragalus amoenus* are listed.

4.2 *Astragalus anthylloides Lam characteristics*

In this study, *Astragalus anthylloides* Lam. was found to be the most demanded species. This species is also known by synonyms such as *Phaca incana* Vahl and *Astragalus foliolosus* Bunge, *Astragalus foliolosus var. meridionalis Hub.-Purple* (Güner, 2012). This species has colorful, eye-catching flowers; its form is remarkable in terms of leaf color and shape and is typically found in shrub and steppe habitats (figure 2). It has been observed growing in stony areas. It has a flowering period of 5-8 months and is a woody, herbaceous plant with practical and showy flowers at the base. The linear character of the leaves and the non-dense texture are harmonious and effective with the flowers. It is a species of Iran-Turkish element, and its distribution areas in Turkey are North, South, and Central Anatolia. Ankara, Konya, Niğde, Zonguldak, Kastamonu, Adana, Elazığ, Denizli, Muğla (Dilaver 2001).

4.3 A sociological analysis of the participants

Upon examining the sociological attributes of the participants, it is evident that there are 73 female and 57 male participants. Regarding age distribution, 16 individuals belong to the 19-29 age bracket, 92 fall within the 30-49 age range, and 22 are in the 50-65 age category. Regarding educational level, there are 17 high school graduates, 15 with associate degrees, 61 with bachelor's degrees, 26 with master's degrees, and 11 with doctorate degrees.

(a) (b)

Fig. 2. (a) *Astragalus anthylloides Lam* general view; (b) *Astragalus anthylloides Lam flowers and leaves view*
(Source: Author)

5.0 Discussion

Astragalus anthylloides Lam has colorful, eye-catching flowers that attract attention due to their form, leaf color, and shape. Some species in factor 2 exhibit remarkable flowers that are in demand and that stand out due to these features. As can be observed in the accompanying photographs, the flowers of this species exhibit an intense and eye-catching flowering. *Astragalus bozakmanii Podlech* and *Astragalus vulnerariae* DC. are species with striking flowers and leaf color. *Astragalus plumosus* and *Astragalus acicularis* attract attention with their pillow-shaped form, leaf colors, and pink flowers. It is conceivable that some species in group 2 exhibit extraordinary flowers and stand out due to these features. The endemic status of the species was not evaluated within the scope of the study; the result could have been more effective.

It is foreseen that this species can be used in highway slope stabilization and highway central refuge, in improving problem areas, in flower pots, flower parterres, rock and roof gardens, private collections and botanical gardens, and arid landscaping applications. It is anticipated that the use of this species will result in a reduction in water consumption, labor, fertilizer, consumables, and maintenance costs. Furthermore, it is believed that the species will help prevent erosion in sloping, stony areas, improve the quality of the landscape, and facilitate the creation of sustainable areas that are compatible with nature.

When compared with the previous studies, it was observed that the analysis method used in this study was not used, the species diversity was not as numerous as in this study, and it did not include the characteristics of occupational groups, and it was not applied to such a number of users in terms of number. It is a unique study compared to similar studies.

6.0 Conclusion & Recommendations

In consideration of the limitations of this study, The investigation focuses on 21 specific Astragalus taxa. The surveys took place at the main campus of the Ministry of Agriculture and Forestry, involving participants with various professional backgrounds who were associated with this campus. This study reveals the most popular and demanded species among those examined. The exploratory factor analysis applied to the questionnaires and the three exploratory factor analyses applied subsequently, along with the factor 2 one-way ANOVA analysis applied at the end, provided the desired result. The study and its findings represent an original contribution to the field of study. It is anticipated that the results will facilitate further research into the production methods of the *Astragalus anthylloides* Lam which are in high demand, and may also inspire production studies on other species included in this research.

For *Astragalus anthylloides* Lam to be used in landscape architecture applications, it is necessary to determine the production methods to be obtained from nurseries. Noscientific research has yet to be identified on production techniques specific to this species. Once the studies to determine the production methods of this species have been completed, a new species will be added to the landscape architecture planting pallet by being included in nurseries. It is predicted that this species can be used in provinces where it is distributed and in places similar to these provinces in terms of climate and altitude, thus increasing the planting success rate.

In future research, it would be beneficial to determine the direction of a similar study as having participants consisting only of landscape architects as a profession. This would expand the boundaries of the place where the survey will be applied and would also allow for the inclusion of employees working in many public institutions, universities, design offices or nurseries. Once more, the content of the questionnaire can be expanded by including headings under each photograph. These headings should be include design criteria, such as line colour, colour texture, flower leaf characteristics and whether the species is endemic or not. This approach allows for the identification of detailed analyses and the revelation of factors influencing the degree of appreciation of the species. Although this may prove challenging, similar studies could be carried out with Astragalus species distributed in different provinces.

Acknowledgment

The authors would like to express their t appreciation to the users who participated in this study. This study is part of a PhD study titled "Determination of the Utilization Potential of Some Astragalus Species Spread Around Ankara Province in Landscape Architecture Studies" in Ankara University Landscape Architecture Department.

Paper Contribution to Related Field of Study

It is important to carry out multipurpose studies on the use of *Astragalus* species in landscape architecture. Considering the species discussed in this study and the interpretation of the data obtained during the survey and analysis phase, it is envisaged that it can be considered as a source for determining the demand for species and similar studies that are likely to be carried out in the future.

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