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Relationship between Soil Properties and Plant Diversity in Semiarid Grassland

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A B S T R A C T

In ecological studies, soil-plant interaction is an important environmental factor. Soil chemical and physical properties affect plant richness and diversity. This study was carried out to investigate the relationship between soil physical and chemical properties, and plant diversity indexes (Shannon-Weiner and Simpson) in semiarid grassland. Plant diversity indexes and soil properties were determined using 34 quadrats (5x5m) on different parent materials (chrome, marble, serpentine, red chalk and red chalk mostra) in semiarid grasslands in the Central Anatolia Region in Turkey. Plant samples were collected and recorded periodically from April to September (the vegetation period) in 2014 for each quadrat. In order to determine the plant richness and diversity indexes, 3 sub-quadrats (1x1m) were randomly added into each of 34 (5x5 m) quadrats. To evaluate the relationship between plant diversity indexes and soil properties, composite soil samples were collected from the four corners, and the center of each quadrat 0-30 cm in depth, and which was mixing of those subsamples. Soil sand-silt-clay contents, soil reaction (pH), bulk density (BD), electrical conductivity (EC), $CaCO_3$ and soil organic matter (SOM) contents were measured. Relationship between plant diversity indexes measured in different months during vegetation period and soil properties of different parent material was statistically analysed using correlation analysis in SPSS 20.0. Modest correlation coefficient was found between the Simpson diversity index and SOM content, sand-silt-clay content, pH and EC for different months in vegetation period.

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Yarı kurak alanlarda toprak özellikleri ve bitki çeşitliliği arasındaki ilişki

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Ö Z E T

Ekolojik çalışmalarda toprak-bitki etkileşimi önemli bir çevresel faktördür. Toprağın fiziksel ve kimyasal özellikleri bitki çeşitliliği ve zenginliğini etkilemektedir. Bu çalışma yarı kurak meralarda bitki çeşitlilik indeksleri (Shannon-Weiner ve Simpson) ile toprağın fiziksel ve kimyasal özellikleri arasındaki ilişkilerin belirlenmesi amacıyla hazırlanmıştır. İç Anadolu Bölgesi'nde bulunan yarı kurak mera alanlarda farklı ana materyaller (krom, mermer, serpantin, kırmızı kalker ve kırmızı kalker mostra) üzerinde 34 kuadrat (5x5m) kullanılarak bitki çeşitliliği indeksleri ve toprak özellikleri belirlenmiştir. Her bir kuadrat için 2014 yılında Nisan ayından başlayarak Eylül sonuna kadar bitki örnekleri periyodik olarak toplanmış ve kaydedilmiştir. Bitki çeşitlilik ve zenginliğini belirlemek için, 34 (5x5m) quadratın her birinde rastgele 3 adet alt kuadrat (1x1m) eklenmiştir. Bitki çeşitliliği indeksleri ve toprak özellikleri arasındaki ilişkiyi değerlendirmek için, kuadratların dört köşesinden ve merkezinden 0-30 cm derinlikten alınan toprak örnekleri karıştırılarak kompozit toprak örneklemesi yapılmıştır. Toprakların kum, kil, toz içeriği; pH, hacim ağırlığı, elektriksel iletkenlik (Eİ), $CaCO_3$ ve toprak organik madde (TOM) içerikleri belirlenmiştir. Vejetasyon dönemi içinde farklı aylar için ölçülen bitki çeşitliliği indeksleri ve farklı ana materyallerden oluşan toprak özellikleri arasındaki ilişki istatistiksel olarak SPSS 20.0 de korelasyon analizi kullanılarak analiz edilmiştir. Vejetasyon dönemi içinde farklı aylarda Simpson çeşitlilik indeki ile toprak özelliklerinden pH, Eİ, kum, kil, toz ve TOM içeriği arasında orta derecede ilişkiler tespit edilmiştir.

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Introduction

In ecological studies, relationships between such as composition and distribution of plant species, parent material, soil and topographic variable and examining the interaction of these properties are very important (Fu et al., 2004). In this context, Shannon-Wiener and Simpson diversity indexes are the most preferred indexes to analysis distribution of plant species in the ecological studies. When compared with these two indexes together, Shannon-Wiener diversity index is more preferred than Simpson Diversity index and this index has objective result and indiscriminate the dominant or rare species (Gülsoy and Özkan, 2008).

The studies done so far in terms of the richness and diversity of plant species, varies according to the land use type and relationship between soil properties and topography has generally examined the of the study (Janssens et al., 1998; Pärtel, 2002; Palmer et al., 2003; Ortega et al., 2004; Bohner, 2005). Ortega et al. (2004) investigated plant diversity using Shannon-Wiener and Simpson diversity indexes in the different land use type by land scale in three different rural areas, have identified more plant species in grassland compared to other areas. In addition, reported that combined with land use characteristics and plant diversity shed light on the feature of land in the interpretation of ecological studies. Yang et al. (2009) have used some soil properties such as pH, soil organic matter, total nitrogen, available phosphorus properties and Shannon-Wiener diversity index for plant diversity, determining the relationship between the soil properties and plant diversity in China riparian desert forest using correlation analysis. As a result of the evaluation of the data obtained, the plant is highly correlated with the diversity of all soil properties, changes of soil organic matter and total nitrogen in soil may have concluded indicator for the determination of plant diversity.

In this study, after the necessary literature researches, aim to determine the relationship between soil properties and plant diversity index in semiarid grassland. In additional to relation, optimal plant diversity index using Shannon-Weiner and Simpson diversity index and soil properties in the study area. In this context, when calculation of species diversity index taking into account soil characteristics, give better results to provide a decisive extent species diversity in the same area in the future.

Material and Method

Study Area

The study area which is located in the district of Çankırı Province Eldivan, is approximately 13 hectares and consists of five different main material (chrome, marble, serpentine, red chalk and red chalk mostra). The chrome parent material 1.083 ha, serpentine 0.076 ha, marble 3.884 ha, red chalk and red chalk mostra 7.801 ha takes up in the study area. Eldivan district is affiliated to Çankırı province and located in the southeast of the province in central Kızılırmak District of Central Anatolia Region and is located in the Çankırı-G31-d4 and Çankırı-G30-c3 map sections on a topographical map with a 1/25 000 scale. According to the meteorological data about study area, the mean annual temperature is 10.4°C, the mean monthly average ranging from -0.7°C (January) to 22°C (July-August); the average annual precipitation is 496 mm., with the maximum monthly precipitation (53 mm) in December and the minimum (21 mm) in July and August (Anonim, 2007). According to the Thornthwaite method (Çepel, 1995), climate type of the study field is “arid- semi humid, mesothermal, moderate excess water in the winter or close to the oceanic climate impact”, which is designated with the symbols $CB'_1sb'_2$.

Plant Sampling

Study area is located A4 square according to the grid system of P.H. Davis (1965-1988) and Iranian-Turan region in phytogeographic respect. In order to determine of the plant richness and diversity indexes (Shannon-Weiner and Simpson), 3 sub-quadrats (1x1m) were randomly added into each 34 (5x5m) quadrats on different parent materials (chrome, marble, serpentine, red chalk and red chalk mostra) in semiarid grasslands. Plant samples were collected and recorded periodically from April to September (the vegetation period) in 2014 in each quadrat. From each plant species at least two pairs of samples were taken and they were placed in the Herbarium of the Faculty of Science of Çankırı Karatekin University after being identified. Komarov (1978), Bor et al. (1969) and particularly the work of “The Flora of Turkey and Eastern Aegean Islands (Davis, 1965-1988)” were used in recognition of the samples of the plants.

Plant Richness and Diversity Indexes

Shannon-Wiener and Simpson diversity index are most preferred compared to other index in ecological studies. When compared with these two indexes together, Shannon-Wiener diversity index is more preferred than Simpson Diversity index and this index has objective result and indiscriminate the dominant or rare species. In this context the determination of plant diversity and richness of the study area, Simpson and Shannon Wiener diversity index were used which is located equation 1, 2, 3, 4, 5.

Shannon-Wiener Diversity Index (H);

$$H=\sum_{i=1}^{S}\left[p_i \log(p_i)\right] \qquad (1)$$

In the equation;

p: represents the relative value of the species. Proportional value of the species “*ln*” is taken and this value is multiplied by the number of species. Negative multiplication value which is total product of the number of all species “*ln*” value multiplied by their own values, gives Shannon-Wiener (H) value (Gülsoy and Özkan, 2008).

Simpson diversity index (D):

$$D=\frac{1}{C} \qquad (2)$$

The index is calculated by the formula in Equation 2. The greater the value obtained here, the greater the proportionality. The C in the Equation 2 is calculated by using Equation 3 as follows.

$$C=\sum_{i=1}^{S} p_i^2 \qquad (3)$$

p_i in the Equation 3 is calculated by the rules of the Equation 4, but usually calculated approximately with equality 5. Here, N_i the number corresponding to the type number, the N_T is the sum of the individual units in the sample.

$$p_i^2=\frac{N_i(N_i-1)}{N_T(N_T-1)} \qquad (4)$$

$$p_i^2=\left(\frac{N_i}{N_T}\right)^2 \qquad (5)$$

Soil Sampling

To evaluate the relationship between plant diversity indexes and soil properties, composite soil samples were collected from the four corners, and the center of each quadrat 0-30 cm in depth, and which was mixing of those subsamples. Soil samples were air-dried in the laboratory, cleaned and sieved through a 2.0 mm screen and stored in plastic bags. Soil samples were analysed for clay, silt, and sand contents by the hydrometer method (Gee and Bauder, 1986) and for soil organic matter (SOM) content by the method of Nelson and Sommers (1982), $CaCO_3$ content using a Schcibler Calcimeter (Allison and Moodie 1965), soil electrical conductivity (EC) and soil reaction (pH) with a glass electrode in soil-distilled water suspension (1:-5) (McLean, 1982), bulk density (BD) measured using volume weight roller (100 cm^3) method (Blake and Hartage, 1986).

Results

In order to determine the floristic composition of the grasslands examined in the study, plant sampling was carried out at 34 different observation points (5x5m quadrates) starting from April to the end of September in the vegetation period of 2014. According to plant sampling, family-, genus-, species-based distributions of plant taxa collected from quadrates in different main materials are given in Table 1. The maximum number of species was determined on the parent material of red chalk mostra, marble, red chalk, chrome and serpentine respectively in Table 1. Vegetation shows variability in areas with different parent material and soil characteristics under the influence of the same climate type. Indeed, as noted by Duran (2013), differences in parent material and soil types play an important role in determining the diversity and distribution areas of plant communities.

Shannon-Wiener and Simpson diversity indices were used to determine plant diversity and richness indexes in the study area. In this context, the descriptive statistics for determining the changes of the plant diversity indices that are examined during the 2014 vegetation period to the parent material are given in Table 2. When Table 2 was examined, the Simpson diversity index was higher while the Shannon-Wiener diversity index was low in all of the study areas. This situation is due to the differences between the calculations of the proportionality in the diversity indices. In the calculation of the proportionality of the Simpson diversity index, the real values of the species are used and the proportions of the species are divided by 1, in the Shannon-Wiener diversity index, the" ln" values of the proportional values of the species presence in the field are taken and multiplied by the number of species. When we examine the results obtained in this direction, April and August have the lowest diversity index values, whereas May, June and July have higher diversity index values.

Descriptive statistics related to the soil characteristics investigated in order to determine the relationships between soil diversity indices and soil characteristics at 34 observation points in the study area are given in Table 3. When Table 3 is examined, it is seen that the volume weight, electrical conductivity and salt content do not change very much depending on the parent material in the examined grassland areas. However, it has been determined that the sand-clay-silt content, $CaCO_3$, soil organic matter (SOM) content and soil reaction (pH) of the soil changed depending on the parent material. When we consider the sand-clay-silt content depending on the main material, Clay, Clay Loam, Sandy Clay Loam, and Sandy Loam classes are usually found in the study area. The highest SOM content in relation to the parent material and vegetation was calculated in the parent material of the red chalk with 34.35 g / kg and the lowest in serpentine with 7.71 g / kg.

Table 1 Distribution of species determined the study area

Parent Material	Family	Genus	Taxa
Red Chalk Mostra	22	56	73
Marble	20	58	72
Red Chalk	18	45	62
Chrome	15	34	38
Serpentine	16	27	31

Table 2 Descriptive statistics of diversity indexes (N: Sampling number, SW: Shannon-Wiener Diversity index, Simp: Simpson Diversity index, Min: Minimum, Max: Maximum, Std Dev: Standard Deviation)

Parent material	N	Parameter	Month	Min.	Max.	Mean	Std Dev.
Chrome	4	SW	April	0.00	0.54	0.13	0.27
		Simp		1.00	1.37	1.09	0.19
	4	SW	May	0.41	1.11	0.82	0.31
		Simp		1.32	2.70	2.09	0.66
	4	SW	June	1.01	1.26	1.15	0.13
		Simp		2.14	3.27	2.85	0.50
	4	SW	July	1.12	1.74	1.52	0.28
		Simp		2.68	4.98	4.17	1.02
	4	SW	August	0.00	0.00	0.00	0.00
		Simp		0.00	1.00	0.75	0.50
Red Chalk	7	SW	April	0.00	0.00	0.00	0.00
		Simp		1.00	1.00	1.00	0.00
	7	SW	May	0.00	1.57	1.10	0.53
		Simp		1.00	4.17	2.92	1.06
	7	SW	June	1.28	2.08	1.67	0.32
		Simp		3.27	7.26	4.99	1.48
	7	SW	July	0.64	1.33	1.02	0.30
		Simp		1.80	3.57	2.69	0.79
	7	SW	August	0.00	0.69	0.37	0.35
		Simp		1.00	2.00	1.49	0.46
Marble	11	SW	April	0.00	0.00	0.00	0.00
		Simp		1.00	1.00	1.00	0.00
	11	SW	May	1.01	1.99	1.51	0.35
		Simp		2.22	6.82	4.22	1.60
	11	SW	June	0.64	1.56	1.15	0.29
		Simp		1.80	4.50	3.09	0.81
	11	SW	July	0.00	1.10	0.65	0.46
		Simp		0.00	3.00	1.75	1.20
	11	SW	August	0.00	1.39	0.61	0.54
		Simp		1.00	4.00	1.90	1.04
Serpentine	3	SW	April	0.00	0.00	0.00	0.00
		Simp		0.00	0.00	0.00	0.00
	3	SW	May	0.00	1.43	0.75	0.72
		Simp		0.00	3.16	1.58	1.58
	3	SW	June	0.60	1.49	1.15	0.48
		Simp		1.69	4.00	3.12	1.25
	3	SW	July	0.00	1.47	0.95	0.82
		Simp		0.00	4.00	2.62	2.27
	3	SW	August	0.00	0.69	0.44	0.39
		Simp		0.00	2.00	1.27	1.10
Red Chalk Mostra	9	SW	April	0.00	0.00	0.00	0.00
		Simp		1.00	1.00	1.00	0.00
	9	SW	May	0.99	1.82	1.41	0.27
		Simp		2.28	5.54	3.69	1.11
	9	SW	June	0.00	1.96	1.17	0.52
		Simp		0.00	6.42	3.11	1.65
	9	SW	July	0.64	1.56	0.98	0.35
		Simp		1.80	4.50	2.49	1.01
	9	SW	August	0.00	0.90	0.18	0.36
		Simp		0.00	2.13	0.90	0.81

The highest content of $CaCO_3$ was detected in the parent material of marble with 263.11 g / kg of red chalk mostra at 383.76 g / kg. When the soil reaction (pH) was classified according to Tüzüner 1990, the soil showed slight acidity (6.62-6.90) in the chromium parent material and mild alkalinity (7.17-7.90) in the other parent materials. Also, the lowest variability coefficient was calculated for pH (1.23-2.37%) among the all soil characteristics examined. (SPSS Institute Inc., 2012). Relationship between plant diversity indexes measured for different month in vegetation period and soil properties across different parent material were statistically analyzed using correlation analysis in SPSS 20.0 (SPSS Institute Inc., 2012). Soil chemical properties correlated more diversity indexes (monthly) than soil physical properties (Table 4). Sand-clay and silt content, SOM, EC, salt and pH content of the soils are significantly correlated to diversity indexes in April and May (Table 4). For April; Simpson diversity index showed a negative correlation with the soil sand content (r=-0.738; P<0.01), while a positive correlation was observed with clay (r=0.680; P<0.01), silt (r=0.527; EC (r=0.368; P<0.05) at moderate and strong level. At the same time, soil organic matter content was moderately significant for both diversity indices (Shannon-Weiner (r=0.333; P<0.05) and Simpson (r=0.351; P<0.05). In May when the vegetation starts, Simpson diversity index and soil sand (r=0.358; P<0.05) are negatively correlated, while with the clay (r=0.498; P<0.01) and pH (r=0.403; P<0.05), EC (r=0.359, P<0.05) and salt (r=0.347, P<0.05) are positively correlated with Simpson diversity index at moderate level. Moderate positive correlations were found between the Shannon-Weiner diversity index and the contents of clay (r=0.438; P<0.01)), pH (r=0.443; P<0.01), EC (r=0.378, P<0.05) and salt (r=0.374; P<0.05). Except for these months, especially in the dry period of the vegetation (July), medium correlation coefficient was found between SOM and Shannon-Weiner (r=0.386; P<0.01) and Simpson (r=0.432; P<0.01) diversity indexes. In addition silt content of soils negatively correlated with Simpson diversity index (r=-0.377; P<0.05) and Shannon-Weiner (r=-0.356; P<0.05) in August.

Table 3 Descriptive statistics of soil properties (BD: Bulk Density, $CaCO_3$: Lime content, SOM: Soil Organic Matter content, EC: Electrical Conductivity, N: Sampling number, Min: Minimum, Max: Maximum, Std Dev: Standard Deviation)

Parent Material	Parametreler	N	Min.	Max.	Mean	Std Dev.
Chrome	Sand (g/kg)	4	332.00	582.00	425.75	108.73
	Clay (g/kg)	4	318.00	343.00	330.50	14.43
	Silt (g/kg)	4	100.00	325.00	243.75	100.78
	BD($gr.cm^{-3}$)	4	1.09	1.76	1.28	0.32
	$CaCO_3$ (g/kg)	4	29.07	36.34	32.34	3.82
	SOM (g/kg)	4	18.13	26.27	52.34	22.92
	pH	4	6.62	6.79	6.71	0.08
	EC (dS/m)	4	0.07	0.09	0.08	0.01
Red Chalk	Sand (g/kg)	7	382.00	482.00	435.57	36.60
	Clay (g/kg)	7	293.00	418.00	350.14	40.09
	Silt (g/kg)	7	200.00	225.00	214.29	13.36
	BD($gr.cm^{-3}$)	7	1.34	2.08	1.66	0.24
	$CaCO_3$ (g/kg)	7	13.08	43.61	25.96	12.71
	SOM (g/kg)	7	13.80	27.90	22.08	5.94
	pH	7	6.90	7.22	7.07	0.15
	EC (dS/m)	7	0.05	0.14	0.07	0.03
Marble	Sand (g/kg)	11	282.00	507.00	386.55	60.02
	Clay (g/kg)	11	318.00	443.00	424.82	38.88
	Silt (g/kg)	11	150.00	275.00	188.64	39.31
	BD($gr.cm^{-3}$)	11	1.29	2.02	1.58	0.23
	$CaCO_3$ (g/kg)	11	34.89	263.11	118.67	81.09
	SOM (g/kg)	11	14.62	31.85	20.52	4.72
	pH	11	7.35	7.90	7.65	0.18
	EC (dS/m)	11	0.08	0.17	0.11	0.03
Serpentine	Sand (g/kg)	3	632.00	707.00	673.67	38.19
	Clay (g/kg)	3	168.00	243.00	201.33	38.19
	Silt (g/kg)	3	125.00	125.00	125.00	0.00
	BD($gr.cm^{-3}$)	3	1.60	1.93	1.80	0.18
	$CaCO_3$ (g/kg)	3	29.07	36.34	32.46	3.66
	SOM (g/kg)	3	7.71	26.09	14.15	10.35
	pH	3	7.17	7.48	7.33	0.16
	EC (dS/m)	3	0.04	0.06	0.05	0.01
Red Chalk Mostra	Sand (g/kg)	9	257.00	382.00	304.22	40.40
	Clay (g/kg)	9	368.00	468.00	420.78	38.41
	Silt (g/kg)	9	250.00	300.00	275.00	17.68
	BD($gr.cm^{-3}$)	9	1.28	1.89	1.57	0.21
	$CaCO_3$ (g/kg)	9	171.53	383.76	269.09	76.94
	SOM (g/kg)	9	12.60	34.35	23.52	6.79
	pH	9	7.37	7.78	7.57	0.12
	EC (dS/m)	9	0.11	0.24	0.16	0.03

Table 4 Correlation analysis for soil properties and plant richness and diversity indexes (SW: Shannon-Wiener Diversity index, Simp: Simpson Diversity index BD: Bulk Density, $CaCO_3$: Lime content, SOM: Soil Organic Matter content, PH: Soil reaction, EC: Electrical Conductivity)

Parameters	SW	Simp	SW	Simp	SW	Simp	SW	Simp	SW	Simp
	April		May		June		July		August	
Sand	-0.036	-0.738(**)	-0.312	-0.358(*)	0.072	0.083	0.016	0.029	0.226	0.205
Clay	-0.139	0.680(**)	0.438(**)	0.498(**)	-0.111	-0.100	-0.253	-0.257	-0.055	-0.006
Silt	0.244	0.527(**)	0.031	0.042	0.004	-0.029	0.292	0.272	-0.356(*)	-0.377(*)
BD	-0.333	-0.334	0.135	0.140	0.046	0.146	-0.165	-0.202	0.068	0.003
$CaCO_3$	-0.143	0.207	0.321	0.327	-0.088	-0.106	0.044	0.000	-0.164	-0.258
SOM	0.333(*)	0.351(*)	-0.330	-0.289	-0.097	-0.161	0.386(*)	0.432(*)	-0.316	-0.284
pH	-0.285	-0.030	0.443(**)	0.403(*)	-0.212	-0.156	-0.271	-0.283	0.205	0.133
EC	-0.122	0.368(*)	0.378(*)	0.359(*)	-0.079	-0.113	-0.093	-0.119	0.085	0.018

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

Discussion and Conclusion

In the study area quadrats (5x5m), starting from April until the end of the vegetation period in August, April and August had the lowest plant richness and diversity index for all parent materials while May, June and July were determined as the highest months. April is the beginning of the vegetation period, and plant species found in this month usually consist of bulbous species that are blossomed in early spring. For this reason, the study areas usually have vegetation which is dominated by single species. This, in particular, caused the diversity indexes to be very low, and not even worth it, especially for April. August is the last phase of the vegetation period of the plants and the vegetation cover is very weak compared to the other months. In August, most plant species found in the other months complete their vegetation period, so the plant variety in the study areas consists of only one or several species. This causes the diversity indices to be very low in August in the study areas.

Floristic characteristics designated for the month of July, shows similarity with those calculated for June. It is because that the Thorntwaite climate classification calculated for the study area in July both is located in the arid period, additionally the plant species identified for this month are similar to those diagnosed in June. When vegetation, plant diversity and richness index of all parent materials are considered together, the highest values of vegetation properties was observed for chrome, red chalk, red chalk mostra and marble, respectively, while the lowest values were observed for serpentine parent material. Plant species grown on serpentine parent material have low density and usually have distinctive flora consisting rare and rare plant species (Gemici et al., 1992; Berisha et al., 2014).

In this context, the lowest number of taxa (31 species) and the highest rate of endemism (29.0 per cent) was calculated for serpentine parent material. Indeed, it is observed that the change of soil properties of serpantine parent material in less than the change of other parent materials. In the study area, the highest soil organic matter (34.35 mg/kg) and nitrogen content (1.72 mg/kg) are estimated in the red chalk mostra, which have more plant diversity and richness of plant species. Also particularly during the dry period when the vegetation declines and the continuity of plant life negatively affected, SOM is the only soil organic matter content in relation with Simpson diversity index. Therefore, studies conducted on similar areas of the present study area, soil organic matter and nitrogen content might be thought to be the indicator soil properties.

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References

Allison LE, Moodie CD. 1965. Carbonate. In: (Black CA, Evans DD, White JL, Ensminger LE, Clark FE and Dinauer RC).Methods of soil analysis, Part 2,. 2nd edition. Madison: American Society of Agronomy and Soil Science Society of America. pp: 1379-1396.

Anonim. 2007. Çankırı-Eldivan meteoroloji bülteni. Ankara: T.C. Çevre ve Orman Bakanlığı Devlet Meteoroloji İşleri Genel Müdürlüğü Kayıtları.

Berisha N, Millaku F, Krasniqi E, Gashi B. 2014. Rare and Endangered Geophyte Plant Species in Serpentine of Kosovo".Ecologia Balkanica, 6(2): 67-74.

Blake GR, Hartge KH. 1986. Bulk Density. IN: (Klute, A). Methods of Soil Analysis, Part I.,Madison: American Society of Agronomy Monograph 9. pp: 363–375.

Bohner A. 2005. Soil chemical properties as indicators of plant species richness in grassland communities. Grassland Science in Europe, 10: 48-51.

Bor NL, Towsend CC, Guest E, Rawi, AA. 1969. Flora of Iraq. Vol: 9. Baghdad, Iraq.

Çepel N.1995. Orman Ekolojisi Ders Kitabı. İstanbul: İ.Ü. Basımevi ve Film Merkezi. Üniversitesi Orman Fakültesi Yayınları, İ.Ü. Yayın No.3886, O.F. Yayın No. 433.

Davis PH. 1965-1985. Flora of Turkey and The East Aegean Islands. Vol: I-IX. United Kingdom: Edinburgh University Press.

Duran,C. 2013. Türkiye'nin bitki çeşitliliğinde dağlık alanların rolü. Biyoloji Bilimleri Araştırma Dergisi, 6 (1): 72-77.

Fu BJ, Liu SL, Ma KM, Zhu YG. 2004. Relationships between soil characteristics, topography and plant diversity in a heterogeneous deciduous broad-leaved forest Near Beijing, China. Plant and Soil, 26:47–54.

Gee GW, Bauder JW. 1986. Particle-size Analysis. In: (Page A L). Methods of soil analysis, Part I, Physical and mineralogical methods. 2nd Edition. Madison: American Society of Agronomy and Agronomy Monograph 9. pp:383-411.

Gemici Y, Seçmen Ö, Ekim T, Leblebici E. 1992. Türkiye'de endemizm ve İzmir yöresinin bazı endemikleri. Ege Coğrafya Dergisi, 6: 61-8.

Gülsoy S, Özkan K. 2008. Tür çeşitliliğinin ekolojik açıdan önemi ve kullanılan bazı indisler. Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi, A(1): 168-178.

Janssens F, Peeters A, Tallowin JRB, Bakker JP, Bekker RM, Fillat F, Oomes MJM. 1998. Relationship between soil chemical factors and grassland diversity. Plant and Soil, 202:69–78.

Komarov VL. 1978. Flora of the U.S.S.R. 30 vols and Index. Jarusalem: Leningrad Press.

McLean E O. 1982. Soil pH and Lime Requirement. In: (Klute A). Methods of Soil Analysis, Part II, Chemical and Microbiological Properties. 2nd Edition. Madison: American Society of Agronomy and Soil Science Society of America. pp:199-224.

Nelson DW, Sommers LE. 1982. Total carbon, organic carbon, and organic matter. In: (Page AL). Methods of Soil Analysis. 2nd edition. Madison: American Society of Agronomy and Soil Science Society of America. pp:539-579.

Ortega M, Elena-Roselló R, García Del Barrio JM. 2004. Estimation of plant diversity at landscape level: a methodological approach applied to three spanish rural areas. Environmental Monitoring and Assessment, 95:97-116.

Palmer MW, José Ramón Arévalo JR, María del Carmen Cob MC, Peter G, Earls PG. 2003. Species richness and soil reaction in a northeastern Oklahoma landscape. Folia Geobotanica, 38: 381-389.

Pärtel M. 2002. Local plant diversity patterns and evolutionary history at the regional scale. Ecology, 83: 2361–2366.

SPSS Institute Inc. 2012. SPSS Base 20.0 User's Guide, USA: IBM Software group.

Tüzüner A. 1990. Toprak ve su analiz laboratuarları el kitabı. Ankara: Köy Hizmetleri Genel Müdürlüğü.

Yang YH, Chen NC, Li WH. 2009. Relationship between soil properties and plant diversity in a desert riparian forest in the lower reaches of the Tarim River, Xinjiang, China. Arid Land Research and Management, 23: 283-296.