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The soil characteristics of some of *Silene* L. species grown in Turkey

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Abstract

Soil characteristics of 19 (21 taxa) *Silene* L. (Caryophyllaceae) species belonging to the sections *Italicae* (Rohrb.) Schischk. *Giganteae* Du Pasquier, *Siphonomorpha* Otth, *Lasiostemones* Boiss., *Sclerocalycinae* Boiss., *Chloranthae* Rohrb., *Tataricae* Chowdhuri and *Otites* (Adams.) Otth were investigated in the Flora of Turkey. Soil characteristics were examined in terms of physical character, water saturation, as chemical characters, salt, organic matter, lime rates, pH (soil reaction) value, phosphorus (P), potassium (K), magnesium (Mg) and calcium (Ca) amounts (ppm). Plant specimens of *Silene* taxa were collected and soil samples were taken from these areas at a depth of 10–30 cm. Soil acidity (pH) with "glass electrode pH meter", Electrical conductivity (ECX103) in the tool "Conductance Bridge", grain diameter of the soil according to the "Hydrometer method of Bouyoucos", phosphorus in soil according to the method "Bray and Kurtz No. 1", in alkaline soils according to "Olsen" method, determination of potassium, calcium, magnesium in soil was made according to "ammonium acetate method". In our study, the soil grown in taxa, clayey, loamy, clayey–loam, most of the taxa are slightly alkaline, all salt–free, very low and high levels of organic matter, lime–free–too much lime, moderate–good phosphorus, deficient–high potassium, poor–moderate amount of calcium, poor–very high rate of magnesium was found to grow in soils. After having been examined, *Silene* species, except for local endemic, it was seen that Turkey has a growing feature in the very different soil character.

Key words: *Silene* L., Caryophyllaceae, Turkey, soil characteristics

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Türkiye'de yetişen bazı *Silene* L. türlerinin toprak özellikleri

Özet

Lasiostemones Boiss., *Sclerocalycinae* Boiss., *Chloranthae* Rohrb., *Tataricae* Chowdhuri, and *Otites* (Adams.) Otth seksiyonlarına ait 19 (21 takson) *Silene* L. (Caryophyllaceae) türünün toprak özellikleri araştırılmıştır. İncelenen toprak özellikleri; fiziksel karekter olarak, suya doygunluk (%), kimyasal karekter olarak ise tuz (%), organik madde (%), kireç (%) oranları, pH (toprak reaksiyonu) değeri, fosfor (P), potasyum (K), mağnezyum (Mg) ve kalsiyum (Ca) miktarları (ppm) olmuştur. Silene taksonlarının örnekleri toplanmış ve bu alanlardan, 10-30 cm derinlikteki toprak örneği alınmıştır. Toprak reaksiyonu (pH) "cam elektrotlu pH metre" ile, elektrik iletkenlik (ECX103) "Conductance Bridge" aletinde, toprakların tane çapları "Bouyoucos'un hidrometre yöntemi"ne göre, topraktaki fosfor (P) "Bray ve Kurtz No. 1" yöntemine göre, alkalen reaksionlu topraklarda "Olsen" yöntemine göre, topraktaki potasyum (K), kalsiyum (Ca), Magnezyum (Mg) tayini "amonyum asetat yöntemine göre yapılmıştır. Yaptığımız araştırmada, taksonların yetiştiği toprakların, killi, tınlı, killi-tınlı, taksonların çoğunun hafif alkali, tamamının tuzsuz, organik madde değerlerinin çok düşük ve yüksek, kireçsiz ve çok kireçli, orta-iyi oranda fosfor (P), düşük-yüksek oranda potasyum (K), zayıf-orta miktarda kalsiyum, zayıf-çok yüksek oranda ise mağnezyuma (Mg) sahip topraklarda yetiştiği tespit

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edilmiştir. İncelenen Silene taksonlarının lokal olanlar endemikler dışında, Türkiye'nin çok değişik toprak özelliklerine sahip alanlarda yetişme özelliğine sahip oldukları görülmüştür.

Anahtar kelimeler: *Silene* L., Caryophyllaceae, Türkiye, toprak karakterleri

1. Introduction

In Turkey, about 10,000 species of plants (12,000 taxa) are naturally grown and about 3,700 of these taxa are endemic to Turkey [1-3]. There are approximately 750 species of the genus *Silene* on earth, and two gene centers of the genus have been identified, one in the Southern Balkan Peninsula and the other in Southwest Asia. Genus *Silene* is represented by 152 species in Turkey [4].

Şen et al. [5] studied on the endemic *Silene lycaonica* Chowd. and *S. anatolica* Melzheimer & A. Baytop in terms of morphological, anatomical and ecological aspects and soil samples taken from the distribution areas of the species were analyzed. Polat and Bağcı [6] have identified the ecological characteristics of *Silene capillipes* Boiss. & Heldr. Soil (edaphic) characters of some species from the Caryophyllaceae family except for the genus *Silene* in Turkey were also researched. Özçelik and Muca [7] have researched the soil analysis of the three *Ankyropetalum* Fenzl widespread species (*Ankyropetalum arsusianum* Kotschy ex Boiss., *A. reuteri* Boiss. & Hausskn.

A. gypsophiloides Fenzl), in the flora of Turkey. Korkmaz et al. [8], some species of Turkey's *Gypsophila* L. studied on the habitat characteristics of taxa. Soil samples were taken from the area where 22 *Gypsophila* taxa were distributed and especially from habitats where plants were intensively grown and analyzed. Korkmaz and Özçelik [9] conducted a study on the soil–plant relationship of annual 10 *Gypsophila* taxa. In this study, effects of soil properties on plant growth were investigated. Selvi et al. [10] was studied in terms of ecological of *Agrostemma githago* L. and *A. brachyloba* (Fenzl) K. Hammer in Turkey. It was found that the soil structure were almost similar in the environments where both species were grown. However, while the amount of phosphorus and zinc is sufficient or more in the environments where *A. githago* grows, it is observed that these elements are less in the environments where *A. brachyloba* grows.

In this study, it is aimed that the physical properties of soils are investigated in terms of the water saturation, and their chemical properties are determined like salt (µS/cm), organic matter (%), lime (%) ratios, pH (soil reaction) values and the ratios, and amounts of the most important elements as macro nutrients phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg).

2. Materials and methods

2.1. Soil material

Samples of the *Silene* taxa examined in the field studies were collected and soil samples were taken from these areas at a depth of 10–30 cm (Table 1). Soil samples were stored in the bags and the analysis of these soil samples were carried out by the following methods at Manisa Provincial Directorate of Agriculture [11].

Table 1. Location of investigated specimens of *Silene*

Station number	Localities
170	A1E Edirne: Edirne-Lalapaşa road, 1,5 km, hills, 150 m 18 vii 2006, K.Yıldız 170. *Silene densiflora* d'Urv.
508A	A1(E) Edirne: Edirne–Lalapaşa road, 0.5–1. km, hills, roadside, 150 m, 27.05.2014, K.Yıldız 508A, M.Kuh. *Silene skorpilii* Vel.
508B	A1(E) Edirne: Edirne–Lalapaşa road, 1.5 km, hills, roadside, 150 m, 27.05.2014, K.Yıldız 508B, M.Kuh. *Silene densiflora* d'Urv.
513	A1(E) Edirne: Keşan, Mecidiye beach, military camp, sea level, 28.05.2014, K.Yıldız 513, M.Kuh. *S. frivadzkyana* Hampe
524	C2 Denizli: Babadağ, Başalan plateau, 8400 m, 30.06.2014, K.Yıldız 524, M.Kuh *S. splendens* Boiss.
529	C2 Denizli: Tavas, Kızılcabölük town, Çakıroluk location, TV Transmitter station area,1550–1650 m, 04.08.2014, K.Yıldız 529. *S. lycaonica* Chowd.
537	C1 Aydın, South of Güzelçamlı, 390 m, 01.05.2015, K.Yıldız 537, G.Ay, M.Kuh, S.Tan *S. italica* (L.) Pers. subsp. *italica*
541	C2 Muğla: East of the city center, lime cliffs, 02.05.2015, K.Yıldız 541, G.Ay. *S. gigantea* L. subsp. *gigantea*
553	C2 Antalya–Elmalı, Yayaçiftlik village, the cliffs, 1050 m, K.Yıldız 553, G.Ay. *S. armena* var. *serrulata* (Boiss.) Coode & Cullen

Table 1. Devam ediyor

554	C2 Antalya–Elmalı, Southeastern rocky slopes from Avlan Lake to Finike, 1000 m, 03.05.2015, K.Yıldız 554, G.Ay. *S. gigantea* L. subsp. *gigantea* *S. swertiifolia* Boiss.
567	C3 Isparta: Yenişarbademli–Eğirdir road, between Pinargözü–Yaka village,1800 m, 06.05.2015, K.Yıldız 567, G.Ay. *S. capitellata* Boiss.
568-A	C3 Isparta: Yenişarbademli–Eğirdir road, between Pinargözü–Yaka village, 1650 m, 06.05.2015, K.Yıldız 568A, G.Ay. *S. lycaonica* Chowd.
568-B	C3 Isparta: Yenişarbademli–Eğirdir road, between Pinargözü–Yaka village, 1750 m, 06.05.2015, K.Yıldız 568B, G.Ay. *S. lycaonica* Chowd.
569	C3 Isparta: Between Yenişarbademli and Aksu, after Yaka village, 1400 m, K.Yıldız, 06.05 2015, K.Yıldız 569, G.Ay. *S. lycaonica* Chowd.
570	B1 Manisa: Sipil mountain, on Çöşmüş the road, rocky hill,1200–1250 m, 09.05.2015, K.Yıldız 570. *S. idaea* Hausskn.
571	B1 Manisa: Sipil mountain, Turgutalp village, 850 m, 09.05.2015, K.Yıldız 571. *S. chlorifolia* Sm.
572A	B1 Manisa: Sipil mountain exit, navigation area,750 m, 09.05.2015, K.Yıldız 572A. *S. italica* (L.) Pers. subsp. *italica*
572B	B1 Manisa: Sipil mountain exit, navigation area,800 m, 09.05.2015, K.Yıldız 572B. *S. italica* (L.) Pers. subsp. *italica*
573	B1 Manisa: Sipil mountain, 650 m, 09.05.2015, K.Yıldız 573. *S. gigantea* L. subsp. *gigantea*
596	C3 Antalya: Güneysu, Morca plateau, over Toptaş, 1650–1750 m, 25.06.2015, K. Yıldız 596, M.Kuh. *S. caramanica* Boiss. & Heldr. var. *caramanica*
598	C3 Antalya:Akseki, Çimi plateau, 1600 m, 26.06.2015, K. Yıldız 598, M. Kuh. *S. isaurica* Contandr. & Quézel
599	C3 Antalya: Akseki, Çimi plateau, rocky–stony areas, 1700–1800 m, 27.06.2015, K.Yıldız 599, M.Kuh. *S. lycaonica* Chowd.
601	C3 Antalya: Akseki–Seydisehir road, 1650 m, 28.06.2015, K.Yıldız 601, M.Kuh. *S. caeseria* Boiss. & Bal.
603	C4 Konya: Bozkır–Soğucak road, oak openings after Soğucak,1500 m, 28.06.2015, K. Yıldız 603, M.Kuh. *S. phyrigia* Boiss., *S. chlorifolia* Sm.
606	C4 Konya, Hadim–Bozkır road, 1700 m, 29.06.2015, K.Yıldız 607, M.Kuh. *S. caramanica* Boiss. & Heldr. var. *caramanica*, *S. laxa* Boiss. & Kotschy
608	C4 Karaman: Ermenek–Mut road, 4. km, rocky areas, 1300 m, 30.6.2015, K.Yıldız 608, M.Kuh. *S. longipetala* Vent.
610	C4 Karaman: Tekeçatı–Damlaçal, rocks,1730 m, 30.06.2015, K.Yıldız 610, M.Kuh. *S. italica* (L.) Pers. subsp. *italica*
612	C4 Karaman: Karaman–Ermenek road, after 8–9 km after crossing Bucakkışla, 1200 m, 30.06.2015, K.Yıldız 612, M.Kuh. *S. chlorifolia* Sm.
615	C4 Karaman: Karaman–Bucakkışla (Ermenek) road is 17 km away from the road, 1300 m, 30.06.2015, K.Yıldız 615, M.Kuh. *S. caramanica* Boiss. & Heldr. var. *caramanica*, *S. longipetala* Vent., *S. otites* (L.) Vibel
616	C5 Konya, Ereğli, above Yellice village, 1900 m, 01.07.2015, K. Yıldız, M. Kuh *S. armena* Boiss. var. *armena*
617	C5 Konya: Ereğli, from Yellice village to Aydos mountain, meadow areas, 2150 m, 01.07.2015, K.Yıldız 617, M.Kuh. *S. italica* (L.) Pers. subsp. *italica*

(K. Yıldız: Kemal Yıldız, M.Kuh: Mehmet Kuh, G.Ay: Güngör Ay, S.Tan: Seçil Tan)

2.2. Soil analysis

Soil reaction (pH): The reaction of soil samples is measured with a "glass electrode pH meter". For the current acidity, soils with 1–2.5% pure water; for cation exchange acidity was soaked with 1–2.5 nKCl for one night and then measuring [12-14]. Electrical conductivity (ECX103): The electrical conductivity of the prepared soil saturation extract at 25 °C was measured as "micron Siemens /cm" on the "Conductance–Bridge" instrument [13, 15]. Total lime: Total lime was determined by Scheibler calcimetry [16]. Grain diameter (body) (Water saturation): Soil grain diameters according to "Bouyoucos' hydrometer method"; soil types were determined according to the international class of grain diameters [12, 14]. Phosphorus in soil (P): According to the modified by Bray and Kurtz No.1" method in acid–reacted

soils, "Olsen" method in alkaline reacted soils. "Spectronic 20D colorimeter". Determination of potassium (K), calcium (Ca), magnesium (Mg) in soil: using "ammonium acetate method" [13, 17]. From the data obtained as a result of these methods, pH, Saatçi et al. [18] and Öztürk et al. [19]; Electrical conductivity (salt), amounts of lime and organic matter, according to Tüzüner [20] and Jackson [13]; phosphorus in soil, other elements; potassium, calcium, magnesium values were evaluated according to Çokuysal and Erbaş [21]. Reference values are given in Table 2.

Table 2. Reference values of soil analysis data

Physical properties	**Chemical properties**							
Water Saturation (ml)	pH (Soil reaction)	Salt (µS/cm)	Lime (%)	Organic matter (%)	Phosphorus (P) (ppm)	Potassium (K) (ppm)	Calcium (Ca) (ppm)	Magnesium (Mg) (ppm)
0 –30 sandy	<4.5 extreme acid	0–2000 salt–free	0–1 lime–free	0–1 very little	1.30 poor	150 deficient	<714 very poor	<80 poor
30 –50 loamy	4.5–5 very strong acid	2001–4000 slightly salty	1–5 less calcareous	1–2 little	1.30–3.26 moderate	150–200 low	715–1428 poor	80–160 moderate
50 –70 clayey–loamy	5.1–5.5 strong acid	4001–8000 moderately salty	5–15 moderate calcareous	2–3 moderate	3.26 good	200–300 sufficient	1429–2143 moderate	161–350 high
70–110 clayey	5.6–6.0 moderate acid	8000–15000 too salty	15–25 much calcareous	3–4 good		300–400 high	2144–2857 good	350–+ very high
110+ heavy clayey	6.1–6.5 mild acid	15001 > extreme salty	25+ too much calcareous	4–+ high		400–+ very high	2858–3571 high	
	6.6–7.3 neutral						3571–+ very high	
	7.4–7.8 slightly alkaline							
	7.9–8.4 alkaline							
	8.5–9.0 strong alkaline							
	9.1–+ very strong alkaline							

3. Results

Soil samples from in which 19 species (21 taxa) belonging to the genus *Silene* were grown, were taken from 33 different areas. Soil analysis taxa are expressed in tables and graphs (Table 3, Figures 1–4).

Table 3. Reference values of soil analysis data (P: phosphorus, K: potassium, Ca: calcium, Mg: magnesium)

	Physical properties	**Chemical properties**							
Species (Station number)	**Water Saturation (ml) and Structure**	**pH (Soil reaction)**	**Salt (µS/cm)**	**Lime (%)**	**Organic matter (%)**	**P (ppm)**	**K (ppm)**	**Ca (ppm)**	**Mg (ppm)**
Silene italica (L.) Pers. subsp. *italica* (537)	93	7.48	445	1.17	8.792	7.55	159	1121	372
	clayey	slightly alkaline	salt–free	less calcareous	high	good	low	deficient	very high
S. italica subsp. *italica* (572A)	49	7.59	281	1.17	2.24	2.06	141	1648	66

Table 3. Devam ediyor

	loamy	slightly alkaline	salt–free	less calcareous	moderate	moderate	deficient	moderate	Poor
S. italica subsp. *italica* (572B)	37	7.5	369	1.17	0.56	5.32	162	1766	584
	loamy	slightly alkaline	salt–free	less calcareous	very little	good	low	moderate	very high
S. italica subsp. *italica* (610)	49	7.82	369	26.52	4.76	4.16	119	1351	71
	loamy	slightly alkaline	salt–free	too much calcareous	high	good	deficient	poor	poor
S. italica subsp. *italica* (617)	72	6.6	830	1.56	10.08	25.92	238	1314	172
	clayey	neutral	salt–free	less calcareous	high	good	sufficient	poor	high
S. splendens Boiss. (524)	72	7.37	425	3.12	5.77	16.49	279	1575	146
	clayey	neutral	salt–free	less calcareous	high	good	sufficient	moderate	moderate
S. gigantea L. subsp. *gigantea* (541)	53	7.89	381	27.69	1.456	1.94	169	1141	28
	clayey–loamy	slightly alkaline	salt–free	too much calcareous	little	moderate	low	poor	poor
S. gigantea subsp. *gigantea* (554)	42	7.74	181	39	1.4	6.51	139	1219	23
	loamy	slightly alkaline	salt–free	too much calcareous	little	good	low	poor	poor
S. gigantea subsp. *gigantea* (573)	52	7.56	343	6.63	2.24	1.83	184	1338	36
	clayey–loamy	slightly alkaline	salt–free	moderate calcareous	moderate	moderate	low	poor	poor
S. longipetala Vent. (608)	77	7.71	503	6.24	5.880	2.75	243	1288	106
	clayey	slightly alkaline	salt–free	moderate calcareous	high	moderate	sufficient	poor	moderate
S. longipetala (615)	75	7.77	574	3.12	5.992	13.28	188	1222	198
	clayey	slightly alkaline	salt–free	less calcareous	high	good	low	poor	high
S. phyrigia Boiss. (603)	42	7.79	530	3.12	1.12	5.31	71	1554	169
	loamy	slightly alkaline	salt–free	less calcareous	little	good	deficient	moderate	high
S. capitellata Boiss. (567)	79	6.26	181	1.17	8.120	13.58	158	1288	204
	clayey	mild acid	salt–free	less calcareous	high	good	low	poor	high
S. isaurica Contandr. & Quézel (598)	65	7.30	265	1.95	3.640	4.49	108	1158	82
	clayey–loamy	neutral	salt–free	less calcareous	good	good	deficient	poor	moderate
S. caramanica var.*caramanica* (596)	63	7.54	765	7.8	3.36	3.16	193	1236	136
	clayey–loamy	slightly alkaline	salt–free	moderate calcareous	good	moderate	low	poor	moderate
S. caramanica Boiss. & Heldr. var.*caramanica* (606)	55	7.74	415	1.56	4.98	20.13	321	1927	236
	clayey–loamy	slightly alkaline	salt–free	less calcareous	high	good	high	moderate	high
S. caramanica var.*caramanica* (615)	75	7.77	574	3.12	5.992	13.28	188	1222	198
	clayey	slightly alkaline	salt–free	less calcareous	high	good	low	poor	high
S. idaea Hausskn. (570)	88	7.2	234	7.41	10.856	8.35	194	1169	107

Table 3. Devam ediyor

	clayey	neutral	salt–free	moderate calcareous	high	good	low	poor	Moderate
S. armena Boiss. var. *armena* (616)	74	7.6	391	1.56	13.16	4.38	275	1242	467
	clayey	slightly alkaline	salt–free	less calcareous	high	good	sufficient	poor	very high
S. armena var. *serrulata* (Boiss.) Coode & Cullen (553)	67	7.48	529	31.2	6.16	8.8	173	1638	143
	clayey–loamy	slightly alkaline	salt–free	too much calcareous	high	good	low	moderate	moderate
S. laxa Boiss. & Kotschy (606)	55	7.74	415	0.78	4.98	20.13	321	1927	236
	clayey–loamy	slightly alkaline	salt–free	lime–free	high	good	high	moderate	high
S. caeseria Boiss. & Bal. (601)	73	6.75	479	31.2	10.08	7.21	297	1944	229
	clayey–loamy	neutral	salt–free	too much calcareous	high	good	sufficient	moderate	high
S. chlorifolia Sm. (571)	50	7.99	108	1.56	2.350	2.93	143	1286	30
	loamy	alkaline	salt–free	less calcareous	moderate	moderate	deficient	poor	poor
S. chlorifolia (603)	42	7.79	530	3.12	1.12	5.31	71	1554	169
	loamy	slightly alkaline	salt–free	less calcareous	little	good	deficient	moderate	high
S. chlorifolia (612)	45	7.74	766	5.46	1.73	4.48	151	1168	190
	loamy	slightly alkaline	salt–free	moderate calcareous	little	good	low	poor	high
S. swertiifolia Boiss. (554)	42	7.74	181	39	1.4	6.51	139	1219	23
	loamy	slightly alkaline	salt–free	too much calcareous	little	good	low	poor	poor
S. lycaonica Chowd. (529)	86	7.54	370	1.56	13.6	5.63	138	1216	105
	clayey	slightly alkaline	salt–free	less calcareous	high	good	deficient	poor	moderate
S. lycaonica (568A)	91	7.54	354	0.78	19.32	7.1	116	1284	350
	Clayey	slightly alkaline	salt–free	lime–free	high	good	deficient	poor	high
S. lycaonica (568B)	67	7.02	360	1.56	6.83	4.88	151	1306	113
	clayey–loamy	neutral	salt–free	less calcareous	high	good	low	poor	moderate
S. lycaonica (569)	40	7.88	251	1.56	1.34	1.62	129	1229	64
	loamy	slightly alkaline	salt–free	less calcareous	little	moderate	deficient	poor	poor
S. lycaonica (599)	75	7.53	730	4.29	8.12	26.57	185	1413	125
	clayey	slightly alkaline	salt–free	less calcareous	high	good	low	poor	moderate
S. frivadzkyana Hampe (513)	33	7.50	88	0.78	0.39	4.80	114	1119	125
	loamy	slightly alkaline	salt–free	lime–free	very little	good	deficient	poor	moderate
S. skorpilii Vel. (508A)	49	7.4	272	0.78	1.4	3.96	182	1353	277
	Loamy	slightly alkaline	salt–free	lime–free	little	good	low	poor	high
S. otites (L.) Vibel (615)	75	7.77	574	3.12	5.992	13.28	188	1222	198
	clayey	slightly alkaline	salt–free	less calcareous	high	good	low	poor	high
S. densiflora d'Urv. (170)	49	7.4	272	0.78	1.4	3.96	182	1353	277
	loamy	slightly alkaline	salt–free	lime–free	little	good	low	poor	high
S. densiflora (508B)	37	7.34	347	7.02	1.176	3.85	159	1218	74
	loamy	neutral	salt–free	moderate calcareous	little	good	low	poor	poor

4. Conclusions and discussion

In terms of physical properties, saturation–body structure was examined (Table 3, Figure 1). The saturation rate of the studied soils was measured between 33–93%. According to these values, taxa were grown in clayey, loamy, clayey–loamy soils. Taxa were found to prefer loamy soils in 14 soil samples. Some species have found a growing environment in different soils. For example, *Silene italica* subsp. *italica* clayey and loamy, *S. lycaonica* clayey, loamy and clayey–loamy can grow in soils. As the distribution area of taxa increases, it can be seen that they spreads in more different soils, while other taxa prefer only certain soils.

In terms of chemical properties; (pH), salt, lime, organic matter, P, K, Ca and Mg values were investigated.

Salinity rates vary between 88 (*S. frivadzkyana*, K. Yıldız 513) and 830 µS/cm (*Silene italica* subsp. *italica*, K. Yıldız 617). According to these measured values, it was determined that all of the studied *Silene* species were grown on salt–free soils. Samples with the least salt content are K. Yıldız 571 (*S. chlorifolia*, 108 µS/cm), K.Yıldız 554 (*S. swertiifolia*, *S. gigantea* subsp. *gigantea*, 181 µS/cm), K.Yıldız 567 (*S. capitellata*, 181 µS/cm). Based on the analyzed habitats, it can be said that other *Silene* taxa have no tolerance to saline soils (Table 3, Figure 2).

Plants generally grow well between pH 6.5–7.5, on the other hand, if value is below or above of this range, it causes negativity in plants [22, 23]. In moist soils, pH value starts just under 5 and rises to the maximum of 7. On the other hand, in arid soil, pH value starts from 7 to 9, and in general terms, pH value is always above 7 in arid soil and below 7 in humid soil. The pH values of the studied soil samples ranged from 6.26 (*Silene capitellata*) to 7.89 (*S. gigantea* subsp. *gigantea*). These values are evaluated between mild acid and mild alkaline. The pH of most of the taxa investigated is between 7.4–7.8 and grows in light alkaline–arid soils (Table 3, Figure 2).

Organic matter has a significant effect on the physical, chemical and biological properties of soils. It has been reported that the richest soils of organic matter are under forest cover and the lowest value soils are formed on young alluvial deposits. In addition, organic matter; is the main source of phosphorus, sulfur and nitrogen in the soil. It accelerates the decomposition of minerals in the soil and affects the uptake of nutrients and also increases the salt tolerance of the soil [24, 25]. According to the percentage of organic matter in the studied soil samples, *Silene* taxa were grown in soils between 0.39–13.32%. Organic matter values are very low and high. The lowest value of organic matter was measured in K. Yıldız 513 (*Silene frivadzkyana*, 0.39%) and the highest value was measured in K.Yıldız 568A (*S. lycaonica*, 19.32%). Among the investigated taxa, such as *S. italica* subsp. *italica* and *S. chlorifolia* species have been observed in habitats with very little or little organic matter. Cosmopolitan taxa (*S. italica* subsp. *italica*) have been observed to be grown in very low and high soils by organic matter and other taxa (*S. lycaonica*, *S. caramanica* var. *caramanica*) in organic soils (Table 3, Figure 2).

When the lime (%) values measured in soil analysis are considered, these values are evaluated between lime–free and too much calcareous soils (Table 3, Figure 2). When the lime content in soils exceeds 15%, much calcareous limits crop production [26]. The highest values were measured in *Silene gigantea* subsp. *gigantea* (K.Yıldız 554, 39%) and *S. armena* var. *serrulata* (K.Yıldız 553, 31.2%) taxa were measured. According to the soil analysis results in the above areas, *S. gigantea* and *S. armena* species have high tolerance to lime. Lime values have the least percentage, the same percentage (0.78%) and these species: *S. laxa* (K.Yıldız 606), *S. lycaonica* (K.Yıldız 568A), *S. frivadzkyana* (K.Yıldız 513), *S. skorpilii* (K.Yıldız 508A), *S. densiflora* (K.Yıldız 170).

Plants grown in soils with low phosphorus increase the uptake of phosphorus, which is insufficient in the environment by making more roots. In soils where phosphorus is low, root hairs increase the absorption surface and penetrate larger soil volumes with a very low radius ratio to significantly increase phosphorus usefulness [27-29]. If the phosphorus ratio in the soil is low; decrease in flower and seed formation and color changes in leaves are observed. Iron (Fe), Zinc (zn), Calcium (Ca), Boron (B) and Manganese (Mn) cannot be purchased in excess phosphorous soils [30].

Measured values in terms of phosphorus (P) content measured in soil analysis ranged from 1.62 to 26.57 ppm. These values are in the moderate–good category. The lowest values among the analyzed samples were in the middle level and the highest values were measured in K.Yıldız 569 (*Silene lycaonica*, 1.62 ppm) and K.Yıldız 573 (*S. gigantea*. subsp. *gigantea*, 1.83 ppm) values were measured in K.Yıldız 599 (*S. lycaonica*, 26.57 ppm) and K.Yıldız 617 (*S. italica* subsp. *italica*, 25.92 ppm) samples (Table 3, Figure 3).

Potassium in soil plays a role in more than one event in plants. It provides the water balance of the plant and provides power for the plant to withstand drought. Potassium (K) content measured in soil analysis measured values vary between 71–321 ppm. These values are in the deficient–high category. In terms of potassium values measured in the analysis, the lowest value was found in K.Yıldız 603 (*Silene phyrigia*, 71 ppm) and the highest value was found in K.Yıldız 606, *S. laxa* and *S. caramanica* var. *caramanica* was measured as 321 ppm. The majority of taxa studied grow on soils with low and deficient potassium (Table 3, Figure 4).

Calcium (Ca) is the third most used plant nutrient. Calcium adjusts pH of soil and plays a role in the uptake of plant nutrients and in the deposition of toxic substances in plants and soil. In terms of calcium content measured in the analyzes, the measured values ranged from 1119–1944 ppm. All taxa are grown in soils with calcium–poor category. The lowest calcium values were measured in K.Yıldız 537 (*Silene italica* subsp. *italica*, 1119 ppm) and the highest value was measured in K.Yıldız 601 (*S. caeseria*, 1944 ppm) (Table 3, Figure 4).

High amounts of aluminum ions in soils with a pH value of 5 or less also reduce magnesium intake and cause deficiency [31]. Magnesium (Mg) content measured in soil analysis ranged from 23–584 ppm in this study. These values are in the poor–very high category. The lowest magnesium value measured in soil analysis was measured in K.Yıldız 554 (*Silene gigantea* subsp. *gigantea*, 23 ppm) and the highest value was found in K.Yıldız 561 (*S. italica* var. *italica*, 584 ppm) samples (Table 3, Figure 4).

Looking at the soil analysis obtained from more than one locality, one of the two most examined species is *Silene italica* subsp. *italica* (5 different localities). *S. italica* subsp. *italica* is among the most common species of *Silene* in the Flora of Turkey. It is loamy in three localities, clayey in two localities, slightly alkaline soils in four localities, neutral soils in one locality, salt–free soils in all localities in terms of salinity properties, less calcareous in four localities in one locality, and more calcareous in three localities in terms of organic matter properties high, in one locality of moderate and much organic matter soils, phosphorus (P) in terms of properties moderate in one locality, good in four localities, in terms of potassium (K) properties sufficient in one locality, low in two localities and again in two localities, calcium (Ca) properties two poor, three localities in the middle value of soils, magnesium (Mg) properties in two localities poor, high in one locality and very high in two localities were found to grow. As seen, *S. italica* subsp. *italica*, a cosmopolitan species, can grow in soils with very different characteristics (Table 3, Figures 1-4).

Likewise, soil samples of the most studied species, *Silene lycaonica* (5 different localities), clayey, loamy and clayey–loamy, slightly alkaline at four locations, neutral soils in one locality, all salt–free soils, four localities less and one locality in lime–free soils, high in four localities, in terms of organic matter properties in soils with little organic matter in one locality, in phosphorus (P) properties high in four localities, good and moderate in one locality, deficient and low value soils in potassium (K) properties, calcium (Ca) properties in poor soils, in terms of magnesium (Mg) poor, moderate and high value of the soils were found to grow (Table 3, Figures 1-4).

According to the soil analysis, *Silene gigantea* subsp. *gigantea* in different two localities, they were grown in soils, in terms of water saturation in two localities clayey–loamy, loamy soil in one locality, the alkaline soils in all localities, salt–free soils in all localities, moderate calcareous in one locality, in two localities very much calcareous, moderate organic matter in a locality, in terms of phosphorus (P) properties good in one locality, good in two localities, potassium (K) properties low in all localities, calcium (Ca) and magnesium (Mg) properties in all localities in poor value soils. As can be seen, *S. gigantea* species can grow on soils with less different characteristics than *S. italica* species spread over larger areas (Table 3, Figures 1-4).

Silene chlorifolia (three different locations), loamy in all soils, alkaline and slightly alkaline in terms of pH properties, all in salt–free soils, in low and moderate calcareous soils in term of lime properties, organic matter in little and moderate soils, in terms of phosphorus (P) properties moderate and good soils, potassium (K) properties in deficient and low value soils, calcium (Ca) properties in poor and moderate value soils, magnesium (Mg) properties in poor and high value soils were found to grow (Table 3, Figures 1-4).

Silene longipetala (two different localities) clayey, slightly alkaline, salt–free, less calcareous and moderate–calcified, high–value organic matter in the soils, phosphorus (P) properties in middle and good soils, potassium (K), in sufficient and low value soils, calcium (Ca) in poor soils, magnesium (Mg) in high and moderate value soils have been identified that they grow (Table 3, Figures 1-4).

Soil samples from three different localities of the species which have two different varieties, *Silene caramanica* var. *caramanica* and *S. caramanica* var. *ilarslanii*, were analyzed. Both varieties grows in clayey–loamy and var. *caramanica* clayey soil in terms of water saturation. It was determined that both varieties were grown in light alkaline and salt–free soils, var. *ilarslanii* were moderate–calcareous soils, var. *caramanica* were grown in less calcareous soils, var. *ilarslanii* good organic matter and var. *caramanica* was grown in high value soils. In terms of phosphorus (P) properties, var. *ilarslanii* moderate, var. *caramanica* in good value soils, potassium (K) properties low and high soils, calcium (Ca) properties poor and moderate soils, in terms of magnesium (Mg), it was found that var. *ilarslanii* were grown on moderate soils and var. *caramanica* were grown on high soils (Table 3, Figures 1-4).

Silene densiflora (2 different localities), loamy, slightly alkaline and neutral, salt–free, lime–free and moderate–lime soils with little organic matter, phosphorus (P) good, potassium (K) low, calcium (Ca) poor, magnesium (Mg) in poor and high value of soils were found to grow (Table 3, Figures 1-4).

Şen et al. [5] have made the soil analysis *Silene anatolica* and *S. lycaonia*. In the study, *S. lycaonica* soil is clayey, pH almost neutral (6.99), trace amounts of salts and moderate–lime were encountered in the soil, the soil was good for the determination of organic matter. It is stated that in terms of mineral content of phosphorus (P) moderate, potassium (K) very high, magnesium (Mg) high and calcium (Ca) sufficient. It is stated that the soil structure in which both species are distributed shows some different features. *S. anatolica* prefers clayey–loamy and slightly alkaline soils, while *S. lycaonica* spreads only in clayey and neutral soils. The element potassium is abundant only in the soil where *S. lycaonica* is grown.

In the present study, soil samples of *S. lycaonica* species from 5 different localities (K.Yıldız 529, 568A, 568B, 569 and 599) were analyzed (Table 3, Figures 1-4). In our study, it was found that *S. lycaonica* had clayey–loamy in three localities, clay–loamy in one locality and loamy in one locality. As in the study of Şen et al. [5], grow is seen that preferred clay soil. In our study, the soil pH value of *S. lycaonica* is between 7.02–7.88 and between neutral and slightly alkaline, in the study of Şen et al. [5], it is seen that grow in soils with similar pH characteristics. Trace amounts of salt

are present in the soil, but also in the salt–free and middle lime has been found and are in parallel with the work of Şen et al. [5]. In terms of organic matter determination, the soils where the species grows are high value except for one sample (K.Yıldız 569, 1.34 ppm) and like the study of Şen et al. [5], except for one sample, grows in with more organic matter soils. Values of *S. lycaonica* species in five different localities and data from Sen et al. [5] study were compared in terms of soil minerals. In our study, it was determined that the amount of phosphorus (P), which is one of the mineral contents in the soil, excep for just one sample, (K.Yıldız 569, 1.62 ppm) is good, on the other hand, potassium (K) amount is low and deficient, magnesium (Mg) amount is poor, moderate and high, and lastly calcium (Ca) amount is poor. According to our findings, phosphorus (P), one of the soil mineral content in Şen et al. [5] study, is higher, potassium (K) is less, magnesium (Mg) is different in values, and lastly calcium (Ca) is less (Table 3, Figures 1-4).

According to the analysis results of the soil samples of *Silene capillipes* Polat and Bağcı [6], they were found that the soil structure was heavy clay, pH showed a weak acidity with 6.40, salt–free was present in the soil and the amount of lime was very high. In the determination of organic matter, it was determined that the organic matter content of the soil was moderate humus, the mineral contents in the soil were high in phosphorus (P), high in potassium (K), high in magnesium (Mg) and calcium (Ca). As a result of soil analysis, the plant habitat of *S. capillipes* was found to be heavy clayey. The species in our study were grown in clayey, loamy, clayey and loamy soils, but no species were grown in heavy clayey soil. *Silene capillipes* is an endemic species with a narrow area distribution and the areas where it grows are around Ermenek (Karaman).

Aktaş et al. [32] in their ecological study on the *Petrorhagia* taxa, physical properties in terms of soil, seven taxa on clayey–loamy, two of them loamy and only a species are grown in clayey soils and soils found that the saturation value of the water varies between 34–95%. The chemical properties of the soil, the total salt values of the soil 36–868 µS/cm, pH values between 6.62–7.76, lime values between 0.07–30.04% and the average P values between 2.13–14.64 (0.0002-0.0014) ppm and K values were analyzed between 32-277 (0.0032-0.0277%) ppm. According to these results, *Petrorhagia* species are grown in salt–free soils, mostly in slightly basic and neutral soils in terms of pH, mostly in moderate-calcareous soils and some in lime-rich soils. When the genus *Petrorhagia* and *Silene* were compared, it was determined that both genera were very similar in terms of physical and elemental values, all salt–free in soils and *Silene* taxa were grown on more calcareous soils.

Korkmaz et al. [8] investigated the soil properties of 22 taxa belonging to genus *Gypsophila* which is the third largest genus of the family Caryophyllaceae in Turkey. Studied *Gypsophila* soils are moderate and generally coarse, more or less salty, salt–free, slightly alkaline, very high and moderately calcareous, low in phosphorus (P), low in organic matter, moderate and rich in potassium (K). In terms of micro elements, it has been determined that they are of different grades and a significant part of them are grown in gypsum fields.

In general, when compared to the soil characteristics of the same number of *Silene* taxa we studied, it has been found to grow in soils, the soils belonging to the genus *Silene* (Table 3, Figures 1-4) are clayey, loamy, clayey–loamy (moderate group–moderate), most of the taxa are slightly alkaline, all are salt–free, very low and high organic matter values, lime–free and much lime, moderate–good phosphorus (P), deficient–high potassium (K), poor–moderate category of calcium (Ca), poor–very high magnesium (Mg). According to this evaluation, *Gypsophila* and *Silene* soil properties are generally similar. Korkmaz and Özçelik [9] examined the soil properties of the annual *Gypsophila* taxa. Soil samples examined in this study are mostly moderate textured (sand and loamy–sandy soils), salt content is very low, generally slightly alkaline and lime content is low to very high. Phosphorus (P) and potassium (K) concentrations of soil samples are generally low. The organic matter content ranges from low to high. In the habitats of taxa, the dominant vegetation type is steppe. Soil characteristics of *Silene* species in our study compared with soil properties of *Gypsophil*a taxa, Korkmaz and Özçelik [9]'s study, although only phosphorus (P) and potassium (K) concentrations are generally low, *Silene* taxa, moderate–good phosphorus (P) differs from the lack–high–potassium (K).

When the studies on different genera similar to the above studies are examined; in the study on two species of the genus *Agrostemma* [10] and in the study on three species of the genus *Ankyropetalum* [7], little differences were observed in terms of soil properties. This is to show the similarity of character, showing us that one of the five most widespread in the Flora of Turkey family, of the family Caryophyllaceae, except endemic species, especially shows that cosmopolitan species usually grows in similar areas.

As a result of our study; the analysis of 33 different soil samples of 21 taxa belonging to 19 species of the genus *Silene* were determined and the values of living environments were determined. *Silene* taxa are resistant to lime, in terms of water saturation, clayey–loamy, loamy and clayey soils, moderate–good level forfor (P), deficient–high potassium (K), poor–moderate calcium (Ca), poor–very high magnesium (Mg), in terms of organic matter, in very little–high values have been found in the areas. According to these data, it was found to be of the species of genus *Silene* that can be grown in almost every region in Turkey.

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The names of the *Silene* species (taxa) belonging to the line numbers in the figures 1-4. 1. 537–*Silene italica* subsp. *italica*, 2. 572A– *S. italica* subsp. *italica*, 3. 572B–*S. italica* subsp. *italica*, 4. 610–*S. italica* subsp. *italica*, 5. 617–*S. italica* subsp. *italica*, 6. 524–*S. splendens*, 7. 541–*S. gigantea* subsp. *gigantea*, 8. 554–*S. gigantea* subsp. *gigantea*, 9. 573–*S. gigantea* subsp. *gigantea*, 10. 608–*S. longipetala*, 11. 615–*S. longipetala*, 12. 603–*S. phyrigia*,13. 567–*S. capitellata*,14. 598–*S. isaurica*,15. 596–*S. caramanica* var. *caramanica*, 16. 606–*S. caramanica* var. *caramanica*, 17. 615–*S. caramanica* var. *caramanica*, 18. 570–*S. idaea*, 19. 616–*S. armena* var. *armena*, 20. 553–*S. armena* var. *serrulata*, 21. 606–*S. laxa*, 22. 601–*S. caeseria*, 23. 571–*S. chlorifolia*, 24. 603–*S. chlorifolia*, 25. 612–*S. chlorifolia*, 26. 554–*S. swertiifolia*, 27. 529–*S. lycaonica*, 28. 568A–*S. lycaonica*, 29. 568B–*S. lycaonica*, 30. 569–*S. lycaonica*, 31. 599–*S. lycaonica*, 32. 513–*S. frivadzkyana*, 33. 508A–*S. skorpilii*, 34. 615–*S. otites*, 35. 170–*S. densiflora*, 36. 508B–*S. densiflora*.

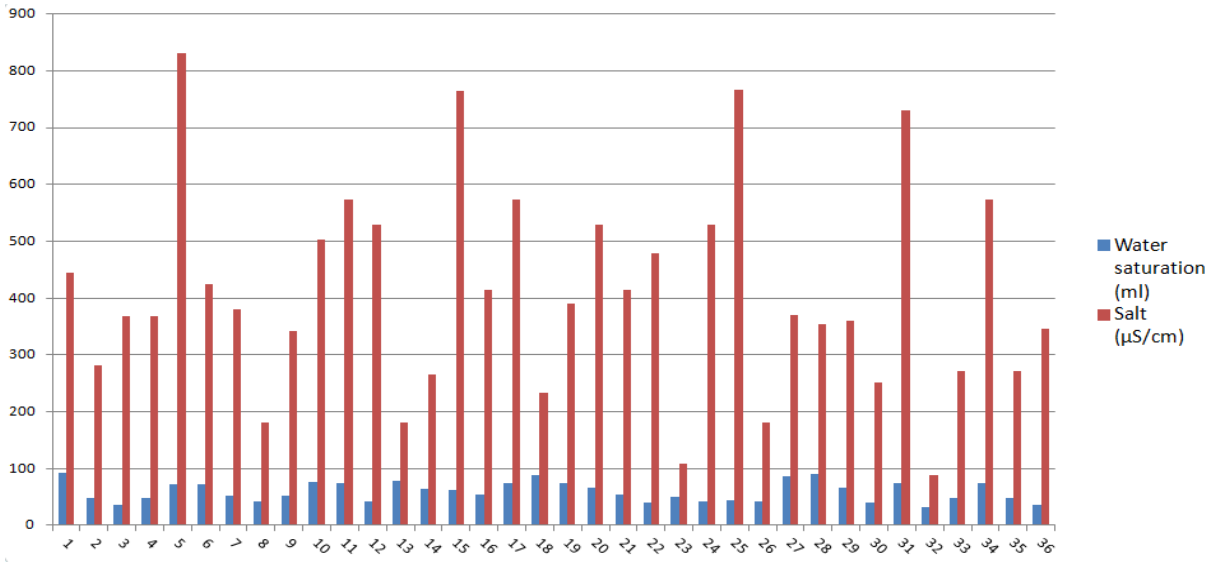

Figure 1. Water saturation (ml) and salt (µS/cm) graph.

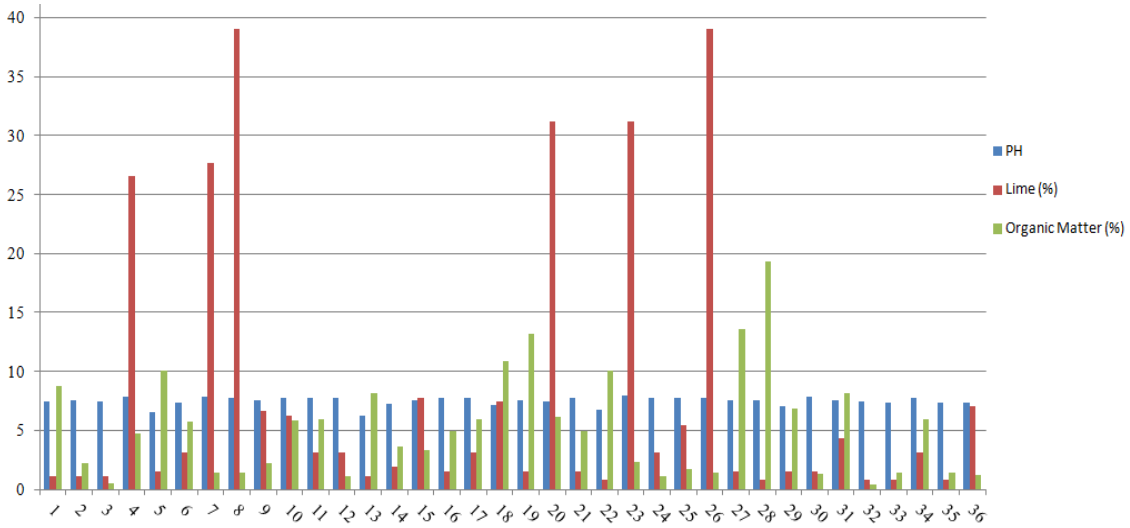

Figure 2. pH, lime (%) and organic matter (%) graph.

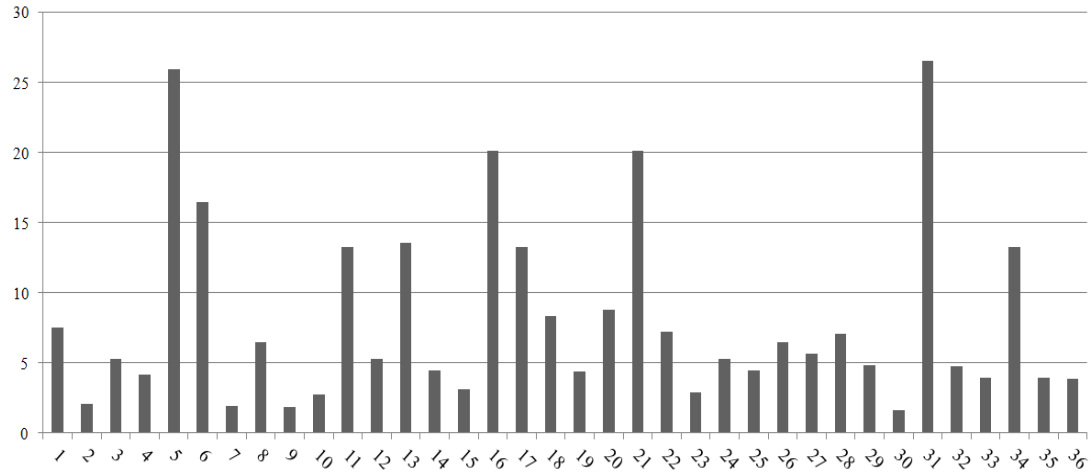

Figure 3. Phosphorus (P) (ppm) graph.

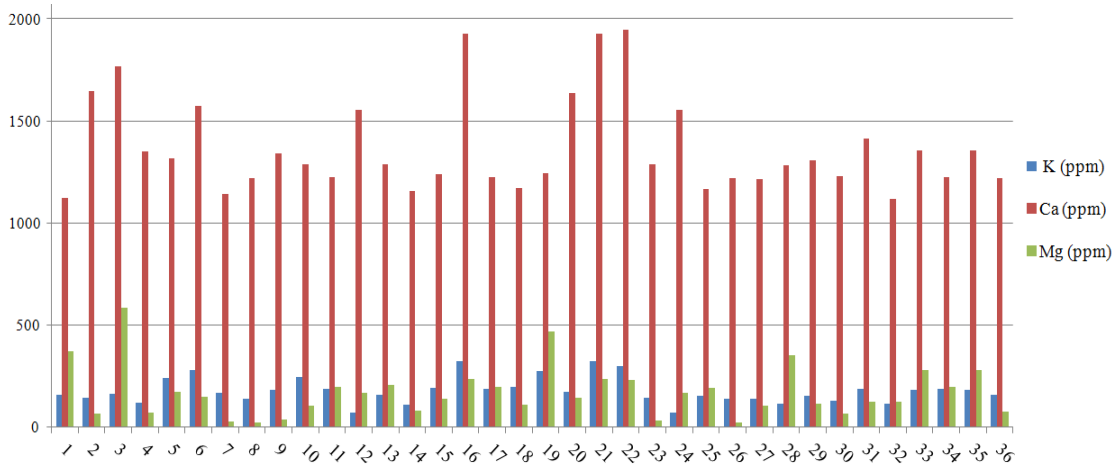

Figure 4. Potassium (K), calcium (Ca) and magnesium (Mg) (ppm) graph.