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Soil Content in the *Anacyclus* L. (Asteraceae) Genus Growing in Turkey

Türkiye'de Yayılış Gösteren *Anacyclus* L. (Asteraceae) Cinsinin Toprak İçeriği

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Abstract

The family Asteraceae, largest known plant family in the world, which comprises approximately 23.000 species in 1535 genera. *Anacyclus* genus is in the Asteraceae family and some of its species are used for medical purposes by people because of flavonoids and terpenoids they contain. This study was conducted on the soil-ecological characteristics of species of *Anacyclus* genus belonging to Asteraceae family which spreads across Turkey. It was determined within the study that 4 species of *Anacyclus* genus spread across Turkey. *Anacyclus anatolicus* Behçet & Almanar, *A. clavatus* (Desf). Pers., *A. nigellifolius* Boiss. *A. latealatus* Hub.-Mor. of these species, *A. anatolicus* and *A. latealatus* species are endemic to Turkey. As soil some phsico-chemical properties; pH, saturation, total salt, organic substance, lime, phosphor, potassium, calcium, magnesium, iron, manganese, zinc and copper values were analysed. As a result of soil; it was observed that the species generally preferred soils with clayey-loamy texture, neutral or slightly alkaline soils in terms of pH, highly limy soils in terms of lime, mid-level or low-level soils in terms of organic substances, high-level or mid-level soils in terms of phosphorus, high soils in terms of potassium, highly salty, slightly salty and saltless soils in terms of saltiness, rich-in-calcium soils, abundant and sufficient soils in terms of magnesium, high-level, mid-level and low-level soils in terms of iron, sufficient soils in terms of manganese and copper and high-level and low-level soils in terms of zinc. As a result, by contributing to cultivation activities with the knowledge of ecological characteristics and soil structure of these species, can put the species with medical value to good use in our country.

Keywords: *Anacyclus*, Asteraceae, macroelement, microelement, Turkey

Öz

Asteraceae familyası dünyada en büyük familyalardan olup, yaklaşık olarak 1535 cins ve 23.000 türden oluşmaktadır. *Anacyclus* cinsi, Asteraceae familyasına ait olup, bazı türleri içerdikleri flavonoidler ve terpenoidler sebebiyle halk tarafından tbbi amaçlarda kullanılmaktadır. Bu çalışma Türkiye de yayılış gösteren Asteraceae familyasına ait *Anacyclus* cinsinin türlerinin toprak ekolojik özelliklerinin araştırılması üzerine yapılmıştır. Çalışma kapsamında Türkiye de *Anacyclus* cinsinin 4 türünün yayılış gösterdiği tespit edilmiştir. Bu türler, *Anacyclus anatolicus*, *A. clavatus*, *A. nigellifolius* ve *A. latealatus*. Bu türlerden *A. anatolicus* ve *A. latealatus* türleri endemiktir. Alınan toprak örneklerinde; pH, saturasyon, toplam tuz, organik madde, kireç, fosfor, potasyum, kalsiyum, magnezyum, demir, mangan, çinko ve bakır değerlerine bakılmıştır. Toprak analiz sonuçlarına göre; türlerin genellikle killi-tınlı tekstürlü, pH olarak nötr ya da hafif alkali, kireç bakımından fazla kireçli, organik madde bakımından orta seviye ve az seviyeli, fosfor bakımından yüksek ve orta seviyeli, potasyum bakımından yüksek, tuz içeriği bakımından, çok tuzlu, az tuzlu ve tuzsuz, kalsiyumca fazla, magnezyum bakımından fazla ve yeterli, demir bakımından fazla, orta ve az, mangan ve bakır bakımından yeterli, çinko bakımından fazla ve az toprakları tercih ettikleri gözlenmiştir. Sonuç olarak, bu türlerin toprak özellikleri ve ekolojik özelliklerinin bilinmesiyle kültüre alma işlemlerine katkı sağlayarak tıbbi değeri olan türlerin ülkemizde değerlendirilmesine faydası olacaktır.

Anahtar Kelimeler: *Anacyclus*, Asteraceae, makroelement, mikroelemet, Türkiye

1. Introduction

Anatolia, which have many plants species because of its geographical position and climate. Autecological studies on economically important plants are of great importance in understanding growth conditions and effective use of these plants (Çelik et al. 2004). As part of the Asteraceae, the largest known plant family in the world (Nylinder and Anderberg 2015), which comprises approximately 23.000 species in 1535 genera (Öztürk and Çetin 2013). Asteraceae family contains economically important species. The family contains food plants, raw material resources, medical and medicinal plants, tender and succulent plants, wild weeds and poisonous plants. Acquisition of esculents such as honey and acquisition of cooking oil from this family is used in many fields such as pharmaceutical industry. In addition to this, many of its species are cultivated as ornamental plants (Süslü et al. 2010). The genus *Anacyclus* (Asteraceae) comprises about 13 annual and perennial species mainly centred in NW Africa but also found in other Mediterranean countries several *Anacyclus* spp. (Asteraceae) have been used in folk medicine, including *A. pyrethrum*, *A. radiatus*, *A. valentinus*, *A. cyrtolepodioide* and *A. clavatus* known for their medicinal properties due to the presence of flavonoids and terpenoids (Selles et al. 2013). This genus is represented by 4 species (*A. anatolicus*, *A. nigellifolius*, *A. clavatus* and *A. latealatus*) in Turkey, and among these species, *A. anatolicus* and *A. latealatus* species are endemic to Turkey and endemism rate is 50%. Besides systematic studies for solving the taxonomic problems of plant species, ecological studies conducted for determining the relationship of species with one another and their environments are also significant.

In this study, pH, saturation, total salt, organic substance, lime, phosphor, potassium, calcium, magnesium, iron, manganese, zinc and copper values were studied by analysing physical and chemical characteristics of soils in regions across which *Anacyclus* taxa belonging to Asteraceae family which spreads across Turkey. In addition, by contributing to cultivation activities with the knowledge of ecological characteristics and soil structure of these species, can put the species with medical value to good use in our country.

2. Materials and Methods

This study was conducted on soil samples of four *Anacyclus* species. Soil samples of these plants were collected from different localities and habitats in Turkey, as seen in Table 1.

Table 1. Soil samples, locatilies, and natural habitats of *Anacyclus* species growing in Turkey

Species	Localities
A. anatolicus	Muş; Malazgirt; Aktuzla of the village eastern slopes, steppe, 1550 m, 06.12.2014.
A. clavatus	İzmir; Menemen, Çamaltı tuzlası, halophilous marsh locations, 30-50 m, 05.08.2014.
A. nigellifolius	Şanlıurfa; Tektek mountains, Rüstem stream, rocky places, 600-700 m, 19.04.2014.
A. latealatus	Burdur; Osmankalfalar vicinity of the village, steppe, 1440-1500 m, 01.06.2014.

The soil samples were obtained from natural habitats of distribution regions during the inflorescense period. The samples were brought into the lab with polyethylene bags in the amount of 0.5-1 kg taken from 0-30 (-40) cm depth after the residuum part which contains plant residues was removed. Then, air-dried soil samples were sieved with a 2 mm sieve and made ready for analysis and then physical and chemical analyses were carried out. The analyses were carried out by the Commercial Enterprise of Agricultural and Animal Products of Balıkesir Commodity Exchange. pH, texture, organic substance, E.C (salt), $CaCO_3$, P, K, Zn, Fe, Cu, Mg, Ca and Mn values of soil samples taken from various localities were analysed in studies. The results were tabulated and evaluated.

3. Results and Discussion

As a result of the soil analyses, it was determined that saturation rate changed between 39.4% and 58.6% (Fig. 1, Table 2). Saturation is a characteristics related to the amounts of large and small particles found in the soil. The particles in the soil are named as follows in order of their sizes: stones and pebbles (with diameters greater than 2 mm), sand (those with diameters between 2.0-0.02 mm), loam (silt) (those with diameters between 0.02-0.002 mm) and clay (with diameters smaller than 0.002 mm) (Kılınç and Kutbay 2008). As a result of the analyses, it was determined that *A. clavatus* and *A. latealatus* samples spread across loamy soils and that *A. anatolicus* and *A. nigellifolia* samples spread across clayey-loamy soils (Fig. 1, Table 2).

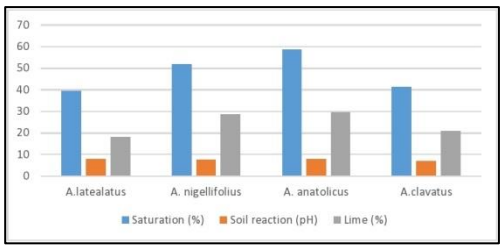

Figure 1. Saturation, pH and Lime contents of *Anacyclus* species

Soil reaction (pH) rate varies between 6.88 and 7.95. Soil reaction is determined by the active H^+ ions found in the soil. As a result of the tests, it was determined that *A. nigellifolius, A.anatolicus* and *A. latealatus* samples

preferred slightly alkaline soils and that *A. clavatus* sample preferred neutral soils. Lime rate varies between 17.8472% and 29.5102% (Fig. 1, Table 2).

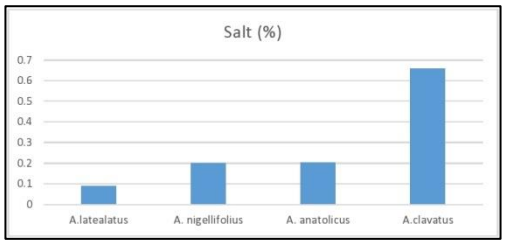

Figure 2. Salt contents of *Anacyclus* species

The carbonate amounts in the soils are one of the soil factors which have an important place in plant physiology, biochemistry and life. The ecologically most important one of carbonates found in soil is $CaCO_3$ (lime) (Kılınç and Kutbay 2008). As a result of the tests, it was determined that *A. nigellifolius* and *A. anatolicus* samples preferred very highly limy soils, *A. latealatus* and *A. clavatus* samples preferred highly limy soils. Salinity rate varies between 0.0883% and 0.6592%. Salinity is the accumulation of salt on soil surface and close to the surface after the separation of water from the soil as a result of evaporation and the emergence of dissoluble salts, which mix into underground waters, on the soil surface with high ground waters through capillarity after being washed in especially arid and subarid climatic zones (Ergene 1982). As a result of the analyses, it was determined that *A. clavatus* sample preferred highly salty soils, *A. anatolicus* and *A. nigellifolius* samples preferred slightly salty soils and *A. latealatus* sample preferred saltless soils (Fig. 2, Table 2).

Table 2. Soil analyses results of *Anacyclus* species growing in Turkey

Taxa	Saturation (%)	Salt (%)	Soil reaction (pH)	Lime (%)	Potassium (K_2O kg/da)	Phosphorus (P_2O_5 kg/da))	Organic matter (%)	Calcium (ppm)	Magnesium (ppm)	Iron (ppm)	Manganese (ppm)	Zinc (ppm)	Copper (ppm)
A.latealatus	39.4 loamy	0.0883 saltless	7.95 slightly alkaline	17.8472 high	43.1641 high	11.6057 high	0.9542 very low	8288 very high	384.3 enough	2.95 medium	6.23 enough	0.41 low	2.07 enough
A. nigellifolius	51.9 clayey-loamy	0.1993 slightly saltly	7.75 slightly alkaline	28.5569 very high	131.1188 high	8.2407 medium	2.2913 medium	12200 very high	341.8 enough	0.46 low	2.22 enough	0.18 very low	1.61 enough
A. anatolicus	58.6 clayey-loamy	0.2025 slightly saltly	7.79 slightly alkaline	29.5102 very high	329.8301 high	24.6305 very high	2.7998 medium	12010 very high	275.2 enough	0.69 low	5.47 enough	0.26 low	1.92 enough
A.clavatus	41.2 loamy	0.6592 very saltly	6.88 neutral	21.0055 high	64.8817 high	68.8328 very high	1.7017 high	7318 high	1118 high	10.24 high	10.91 enough	3.75 high	2.78 enough

Potassium rate investigated species varies between 43.1641 kg/da and 329.8301 kg/da. Potassium and phosporus rates are comparatively shown in Fig. 3. Potassium, which located primary and secondary minerals is one of the effective elements affecting the biochemical and physiological mechanisms of plants in reducing the diseases effects among food elements necessary for plant growth and functions (Geyik and Yılmaz 2000). It was determined as a result of the analysis that all *Anacyclus* samples preferred soils with a high potassium rate. Phosphorus rate varies between 8.2407 kg/da and 68.8328 kg/da (Fig. 3).

Phosphorus, one of the most important nutrients for plants, is in an important position as energy source in plant metabolisms and as a constituent of proteins (Derici and Ağca 1995). As a result of the analyses, it was determined that *A. anatolicus* and *A. clavatus* samples preferred very high phosphorus soils, *A. latealatus* sample preferred high phosphorus soil, and *A. nigellifolius* sample preferred medium phosphorus soil. (Fig. 3, Table 2). Organic substance rate varies between 0.9542% and 2.7998% (Fig. 4, Table 2).

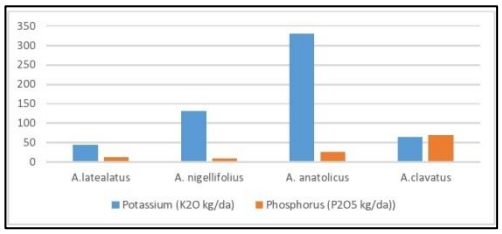

Figure 3. Potassium and Phosphorus contents of *Anacyclus* species

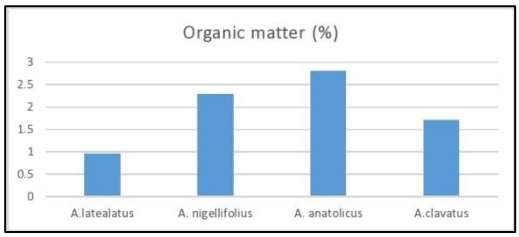

Figure 4. Organic matter contents of *Anacyclus* species

The formation of soil organic substances occurs as a result of many physical and chemical occurrences (Kılınç and Kutbay 2008). Soil organic substance is more abundant in moist and cool climates rather than hot and dry climates. The amount of organic substance increase especially in the surface layers of soils with increasing altitudes, which might be due to decreased activity of microorganisms as a result of decreased temperatures (Yeşilbudak et al. 2013).

It was determined as a result of the analysis that *A. clavatus* sample preferred soils containing high amounts of organic substances, *A. anatolicus* and *A. nigellifolius* samples preferred soils containing organic substances at medium and *A. latealatus* sample preferred soils with very low amounts of organic substances. Calcium rate varies between 7318 ppm and 12200 ppm (Fig. 5, Table 2). Calcium is absorbed from the soil as Ca(II) ions in plants. Agglomeration is seen more in older textures. It regresses the nitrates taking part in the formation of proteins, as well as strengthening cell walls (Gültekin and Örgün 1994). It was determined as a result of the analysis that *A. latealatus, A. nigellifolius* and *A. anatolicus* samples preferred soils containing very high amounts of calcium while *A. clavatus* sample preferred soils with high calcium. Magnesium rate varies between 1118 ppm and 275.2 ppm (Fig. 5, Table 2).

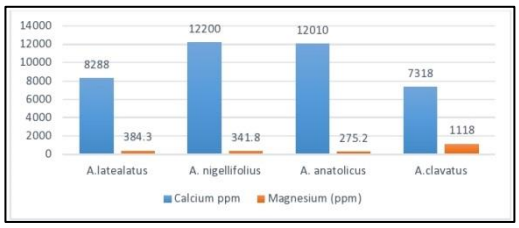

Figure 5. Calcium and Magnesium contents of *Anacyclus* species

Magnesium is absorbed from the soil as Mg(II) ions by the plants. It takes part in the formation of chlorophyll molecules in the plant structure. Another important function of magnesium is seen in the metabolism of phosphor, nucleic acid, energy and protein. The low soils it contains are used as a component for fertilizers (Gültekin and Örgün 1994; Derici and Ağca 1995; Yeşilbudak et al. 2013). *A. latealatus, A. nigellifolius* and *A. anatolicus* samples preferred soils containing sufficient amounts of magnesium while *A. clavatus* sample preferred soils with high magnesium. Iron rate varies between 0.46 ppm and 10.24 ppm (Fig. 6, Table 2). Iron is an element closely related to taking part in the functioning of many enzyme groups and chlorophyll formation and physiological functions in plants. The plants take iron in Fe^{+2} form (Vatansever et al. 2015). It was determined as a result of the analysis that *A. clavatus* sample preferred soils containing high amounts of iron, *A. latealatus* preferred soils with medium iron and *A. nigellifolius* and *A. anatolicus* samples preferred soils containing low amounts of iron. Manganese rate varies between 2.22 ppm and 10.91 ppm (Fig. 6, Table 2). Manganese (Mn) is an essential micronutrient in most organisms. In plants, it participates in the structure of photosynthetic proteins and enzymes (Millaleo et al. 2010). It was determined as a result of the analysis that all *Anacyclus* samples spread across soils with sufficient manganese rates. Zinc rate varies between 0.18 ppm and 3.75 ppm (Fig. 6, Table 2). The plants take the zinc as Zn(II). Zinc is important for plant growth, as plants require a proper balance of all the essential nutrients for normal growth and optimum yield (Sadeghzadeh 2013). It was determined as a result of the analysis that *A. clavatus* sample preferred soils containing high amounts of zinc, *A. latealatus* and *A. anatolicus* samples preferred soils containing low amounts of zinc and *A. nigellifolius* sample preferred soils containing very low amounts of zinc. Copper (Cu) rate varies between 1.61 ppm and 2.78 ppm (Fig. 6, Table 2).

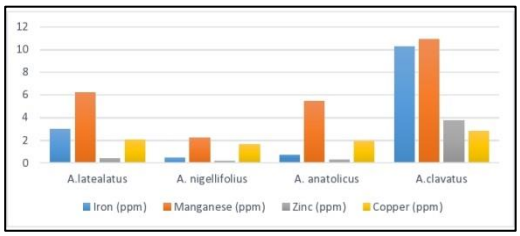

Figure 6. Iron, Manganese, Zinc and Copper contents of *Anacyclus* species

Cu, act as a structural element, which is important in terms of the plant physiology, photosynthetic electron transport, mitochondrial respiration, cell wall metabolism and hormone signaling (Yrulea 2005). It was determined as a result of the analysis that all *Anacyclus* samples preferred soils with a sufficient rate of copper. Due to the increasing human population, studies and expenditures on soil usage and utilisation capacity to obtain the maximum output are increasing gradually. The provision of energy and material flow in nature, paving the way for the formation of vegetative biomass, and forming habitats for organisms living in it are among the significant functions of soil (Korkmaz and Özçelik 2013). Knowledge about the soil preferences of *Anacyclus* species, which are of medical importance and have a natural distribution in Turkey and a high rate of endemism, is important for botanists and florists.

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