

## ECOLOGICAL FEATURES OF *CENTAUREA* L. SECTION *PHALOLEPIS* (CASS.) DC. IN TURKEY

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**Abstract.** In this present study, the ecological characteristics of *Phalolepis* (Cass.) DC. a section of the *Centaurea* L. genus growing in Turkish was investigated. Important to note is that all species of the section are restricted endemics. Physico-chemical soil analyses as well as chemical analyses of different parts of the species were conducted. Soil and bedrock samples were investigated resulting in petrographic diagnoses. Discriminant analyses were used to determine the amount of the plant nutritional elements of the different plant parts such as root, stem, and leaf, depending on physical and chemical features of 0-10 cm soil specimens. The amount of the nutrient elements in the roots, stem and leaves, the classification success percentages were 92.3, 92.3 and 88.5, respectively. The discrimination analysis success percentage of the chemical and physical soil contents resulted in 96.2%.

**Keywords:** *ecology, Centaurea, soil, plant, analysis*

### Introduction

Ecological areas are the result of geological, paleogeographic and historical factors where protected areas are determined based on endemic species (Olson and Dinerstein, 1998; Mittermaier et al., 1998; WWF and IUCN 1994-2001). Islands, mountains or isolated edaphic systems such as ultrabasic rocks, gypsum or limestone areas are generally classified as endemic plant areas (Favarger, 1972; Gomez-Campo et al., 1984). Widespread species become rare depending on the effects of humans on nature. Naturally rare and aquainted rare species are not distinguished easily (Rabinowitz et al, 1986; Gaston, 1994; Norton and De Lange, 1998). Restricted areas such as rocky slopes and cliffs are one of the major reasons for naturally rare plant species (Gaston, 1994). This kind of natural isolations and extreme habitats may lead to formations of local endemic and naturally rare plant species (Wyatt, 1997; Larson et al., 2000; Hopper, 2000). Geographical locations, ecological characteristics, paleogeography and historical features make Turkey rich for its flora. Although Turkey is about one fifth of Europe it has relatively more endemic plant species when compared. Approximately 30% of Turkish Flora is endemic, while all Europe consists about 2750 endemic plants (Ekim et al., 2000).

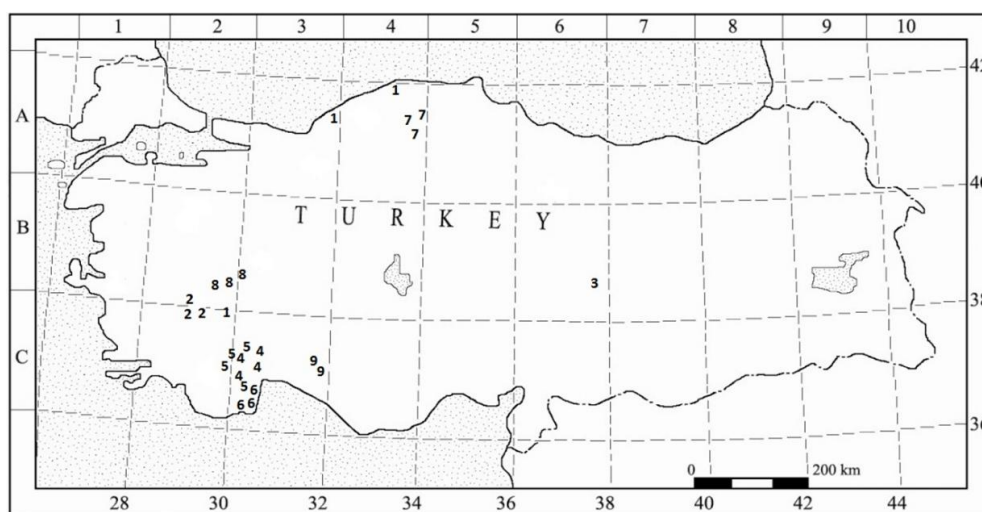
Globally around 700 *Centaurea* L. species are present in Asia, North Africa and America (Brummitt, 2004). The genus *Centaurea* is represented in Turkey by 34 sections, 226 species and the overall endemism rate is 66 % (Kültür, 2016). All of the *Phalolepis* section species are restricted endemic species, one of them is classified as NT (Near Threatened), 4 species are EN (ENdangered), and 4 species are CR (Critical Endangered) (IUCN, 2001).

The main purpose of the study was to determine ecological features of the section *Phalolepis*.

## Materials and Methods

Studied species were collected from their natural habitats between 2003-2005 (see *Table 1, Fig. 1*). Petrographic diagnoses were made both for soil and bedrock samples of plant species. Geological features of all section members were investigated by comparing Turkey geological map (1/500 000 scales), which was previously prepared by the Mineral Research and Exploration Institute (Duberted, 1973).

Plant samples of the root, stem and leaves were evaluated in detail, respectively. Chemical analyses were made by Semi-Micro Kjeldhal method for N (Jackson, 1962), Olsen method for P (Chapman and Pratt, 1961); Ca, Mg, K, ammonium-acetate; Na, sodium-acetate (Jackson, 1962); Fe, Cu, Zn and Mn wet digestion method (Walkley and Black, 1934). Also, 0-10 cm depth soil samples of the plants were collected from the areas, which were dried and color of the samples were compared with Standart Soil Color Charts (1970). Physical analyses of soils were made by Bouyoucus hydrometer method (1962), and soil types were determined using soil types utilizing triangle (Çepel, 1983). Chemical analyses of soils were made with Beckman and pH meter about 0,01 sensitivity (Jackson, 1962). Soil reaction was observed the in 1/2.5 ratio of suspension, the values of soil pH were compared with Kantarcı (2000). The amount of salt in the soil was determined by Conductance Bridge device (Jackson, 1962), and the results were compared with Eruz (1979). Amounts of CaCO<sub>3</sub> of soils were determined with Scheibler (Çepel, 1983), and the results were compared with Tüzüner (1990). Total N amounts of soils were determined by micro Kjeldahl Method (Jackson, 1962), and compared with Schröder (1972). Organic soil contents and Fe, Cu, Zn and Mn analyses were determined by the combustion method of Walkley and Black (1934). P amount was determined by Olsen method (Chapman and Pratt, 1961). Soil extracts were prepared for ammonium-acetate method (Jackson, 1962), and the results were evaluated comparing with Schröder (1972). Discrimination method was used for plant nutrient elements and soil types. Statistical analyses were performed using SPSS 10.0 software.



**Figure 1.** Study fields

**Table 1.** The localities of *Phalolepis* section

|          | Species                 | Sample area | Locality   |
|----------|-------------------------|-------------|--|
| <b>1</b> | <i>C. cadmea</i>        | 1           | Denizli: Honaz, National Park way, cliff, 804 m, 24 vi 2004, K 37° 44' 58.2", D 29° 16' 07.3"                      |
|          |                         | 2           | Zonguldak: Devrek-Eğerci way, Yeşilöz village, cliff, 330 m, 19 vi 2004, K 41° 05' 42.4", D 31° 50' 06.2"          |
|          |                         | 3           | Bartın: Ulus, Ulukaya waterfall, cliff, 275 m., 6 ix 2005, K 41° 40' 07.4", D 32° 45' 59.8"                        |
| <b>2</b> | <i>C. aphrodisea</i>    | 1           | Aydın/Denizli: Geyre-Tavas way, rood side, rocky slopes, 1022 m, 25 vi 2004, K 37° 39' 53.0" D 28° 51' 52.7"       |
|          |                         | 2           | İzmir: Ödemiş, Bozdağ, Ski center road, cliff, 1200 m, 25 vii 2004, K 38° 21' 07.8" D 28° 05' 19.6"                |
|          |                         | 3           | Denizli: Başkarcı village, İsrail waterfall, Picnic area, rocky slopes, 933 m, K 37° 55' 42.6" D 29° 08' 07.4"     |
| <b>3</b> | <i>C. amaena</i>        | 1           | Kayseri: Exit of Yılanlı mountain, rood side, cliff, 1194 m, 14 vii 2004, N 380 42' 55.4" E 350 25' 18.2"          |
|          |                         | 1           | Antalya: Antalya-Korkuteli way, 20. km, rood side, cliff, 538 m, 2 vi 2003, K 37° 01' 35.7" D 30° 27' 39.6"        |
| <b>4</b> | <i>C. lycia</i>         | 2           | Antalya: Saklıkent way, 9 km before the plants, rocky slopes, 1142 m, 5 vii 2003                                   |
|          |                         | 3           | Antalya: Kozdağı, Tahtalı resting place road, rocky slopes, 1130 m, 5 vii 2003, K 36° 53' 51.5" D 30° 22' 21.5"    |
|          |                         | 4           | Burdur: Kızılkaya-Korkuteli way, Steep cliff, 844 m, 2 vii 2005, K 36° 18' 32.6" D 30° 21' 26.9"                   |
|          |                         | 1           | Antalya: Between Elmalı-Korkuteli, Karaman beli, cliff, 1300 m, 5 vii 2003, K 36° 56' 52.5" D 30° 09' 43.8"        |
| <b>5</b> | <i>C. luschaniana</i>   | 2           | Antalya: Elmalı-Korkuteli way, rood side, limestone rocks, 1156 m, 4 vii 2003, K 36° 45' 09.6" D 29° 54' 22.6"     |
|          |                         | 3           | Antalya: Between Korkuteli-Elmalı, 30. km, 1308 m, 4 vii 2003, K 36° 56' 37.7" D 30° 07' 04.4"                     |
|          |                         | 4           | Antalya: Between Korkuteli-Elmalı, 14. km, cliff, 1265 m, 3 vii 2005, K 36° 58' 17.3" D 30° 09' 05.7"              |
| <b>6</b> | <i>C. wagenitzii</i>    | 1           | Antalya: Adrasan, Sazak way, under red pine, 18 m, 23 v 2004, K 36° 18' 52.4" D 30° 28' 00.0"                      |
|          |                         | 2           | Antalya: Adrasan, southwest of cost, walkways, <i>macchia</i> , 3 m, 9 vi 2004, K 36° 17' 53.8" D 30° 28' 25.6"    |
|          |                         | 3           | Antalya: Adrasan, southwest slopes, <i>macchia</i> , 13 m, 3 vii 2005, K 36° 17' 54.1" D 30° 28' 26.5"             |
| <b>7</b> | <i>C. tossiensis</i>    | 1           | Kastamonu: Between Tosya-Kastamonu, roodside, open forest area, 1048 m, 5 ix 2005, K 41° 11' 25.0" D 34° 01' 40.7" |
|          |                         | 2           | Kastamonu: Daday, between Hasanağa-Çayözü, stony slope, 1035 m, 5 ix 2005, K 41° 35' 05.7" D 33° 30' 00.7"         |
|          |                         | 3           | Kastamonu: <b>between</b> Kastamonu-Araç, Ahlatçık village road, forest clearance, 1154 m, 6 ix 2005               |
| <b>8</b> | <i>C. hieropolitana</i> | 1           | Afyon: Between Dazkırı-Çardak, Sarıkavak village, pond side, 974 m, 2 vii 2003, N 37° 53' 29.4" E 29° 48' 32.4"    |
|          |                         | 2           | Denizli: Pamukkale, The front of travertine, 318 m, 24 vi 2004, N 37° 55' 20.4" E 29° 07' 00.7"                    |
|          |                         | 3           | Afyon: Exit of Dazkırı, steppe- <i>Peganum harmala</i> union, 870 m, 24 vi 2004, N 37° 53' 56.7" E 29° 51' 08.9"   |
| <b>9</b> | <i>C. antalyense</i>    | 1           | Antalya: Akseki, Güzelsu way, Serebel well side, under <i>P. brutia</i> , 1090 m, 6 vii 2003                       |
|          |                         | 2           | Antalya: Sadıklar-Güzelsu way, under <i>Cedrus</i> , 1077 m, 3 vii 2055, K 36° 54' 46.1" D 31° 48' 48.3"           |

## Results and Discussion

### *Bedrock and Geology*

Sample area of *C. cadmea* in Denizli-Honaz, bedrock is metamorphic schist while the geological structure is paleozoic; in Zonguldak-Devrek-Eğerci, main rock is andesite, the geological structure is Eocene, Paleocene, and Cretaceous; in Bartın-Ulus, bedrock is limestone and the geological structure is Cretaceous. Sample area of *C. aphrodisea* in Ödemiş-Bozdağ, bedrock is mica schist while the geological structure is paleozoic; in Aydın-Geyre, bedrock is mica schist, the geological structure is Neogene; in Denizli-Başkarıcı, bedrock is crystallized limestone and the geological structure is paleozoic. Sample area of *C. amaena* in Kayseri-Yılanlı Mountain, bedrock is agglomerate and the geological structure is paleozoic. Sample areas of *C. lycia* in Antalya-Korkuteli road, Antalya-Kozdağı, Burdur-Kızılkaya and Antalya-Saklıkent main rocks are limestones and the geological structures are Mesozoic-tertiary in Antalya-Korkuteli road, Antalya-Kozdağı, and Antalya-Saklıkent. The geological structure of Burdur-Kızılkaya is Holocene. All sample areas of *C. luschaniana* main rocks are limestones, in Karaman beli, between Elmali-Korkuteli 30 km and 14 km geological structures are Holocene, and in the other locality geological structure is Miocene. In three localities of *C. wagenitzii* bedrocks are alluvial, and the geological structures are Quaternary. Sample area of *C. tossiensis* on road side, bedrock is serpentine, the geological structure is Eocene; in Tosya bedrock is ultrabasic rocks, the geological structure is Neogene; in Daday bedrock is ultrabasic rocks and the geological structure is Cretaceous. Sample area of *C. hieropolitana* in Sarıkavak village between Dazkırı-Çardak main rock is marl, the geological structure is Oligocene; in the exit of Dazkırı bedrock is limestone, the geological structure is Quaternary; in Denizli-Pamukkale bedrock is travertine and the geological structure is paleozoic. Sample areas of *C. antalyense* in Güzelsu-Serebel well side and Sadıklar-Güzelsu way both two localities have limestone bedrocks and upper Cretaceous as the geological structures.

### *Plant Analysis*

The amounts of nutrient elements of plants roots are seen in *Table 2*. The highest amount of N have been found 3.1351% and is seen on the second sample area of *C. cadmea*. The lowest one is 0.3327% and is seen on the fourth sample area of *C. luschaniana*. The highest Mg rate (10250 ppm) is seen on the first sample area of *C. aphrodisea* and the highest Zn amount (419.5 ppm) is seen on the first sample area of *C. luschaniana*.

The amounts of nutrient elements of the plants stems has given in *Table 3*. The analyses show the stems have lower N amounts than the roots. A third sample area of *C. wagenitzii*, second sample area of *C. tossiensis* and third sample area of *C. hieropolitana* stems have higher N rates than the roots. A third sample area of *C. wagenitzii* has the highest Na (1300 ppm), third sample area of *C. cadmea* has the highest Fe (2500 ppm), first sample area of *C. lycia* has the highest Cu (125.5 ppm) rates.

**Table 2.** The nutrient elements of species roots

| Species                 | Locality | N<br>% | Na<br>ppm | Mg<br>ppm | Ca<br>ppm | Fe<br>ppm | K<br>ppm | Mn<br>ppm | Zn<br>ppm | Cu<br>ppm | P<br>ppm |
|-------------------------|----------|--------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|----------|
| <i>C. cadmea</i>        | 1        | 1,0603 | 400       | 1715      | 31795     | 2130      | 15000    | 167,5     | 39        | 30        | 1550     |
|                         | 2        | 3,1351 | 450       | 1555      | 14525     | 1430      | 11000    | 398,5     | 71        | 29,5      | 550      |
|                         | 3        | 1,0564 | 700       | 1595      | 29760     | 2310      | 15250    | 140,5     | 31,5      | 31,5      | 1650     |
| <i>C. aphrodisea</i>    | 1        | 1,3938 | 225       | 10250     | 9500      | 2970      | 6250     | 152       | 38        | 15,5      | 525      |
|                         | 2        | 1,8704 | 575       | 1335      | 8680      | 1080      | 13500    | 96,5      | 10,5      | 11        | 450      |
|                         | 3        | 0,7167 | 450       | 1635      | 25620     | 1920      | 7000     | 209       | 57        | 18        | 700      |
| <i>C. amaena</i>        | 1        | 1,4651 | 350       | 1185      | 21450     | 445       | 8000     | 77        | 71        | 30        | 950      |
|                         | 1        | 2,0476 | 1500      | 1250      | 17590     | 445       | 15000    | 43,5      | 90        | 33,5      | 1550     |
| <i>C. lycia</i>         | 2        | 1,1029 | 575       | 1175      | 4740      | 680       | 7250     | 82        | 72,5      | 20        | 1050     |
|                         | 3        | 1,4509 | 625       | 1010      | 7915      | 215       | 10500    | 14        | 72        | 9         | 900      |
|                         | 4        | 1,2018 | 625       | 2130      | 22805     | 3995      | 11000    | 154,5     | 37        | 20,5      | 1300     |
| <i>C. luschaniana</i>   | 1        | 1,1653 | 775       | 1780      | 13495     | 2025      | 10500    | 113,5     | 419,5     | 37        | 1250     |
|                         | 2        | 0,8293 | 600       | 940       | 8675      | 980       | 8750     | 90        | 84        | 44        | 700      |
|                         | 3        | 0,969  | 350       | 995       | 14485     | 1335      | 6250     | 91        | 80,5      | 56,5      | 950      |
|                         | 4        | 0,3327 | 575       | 1135      | 15300     | 520       | 8750     | 42,5      | 18,5      | 13,5      | 450      |
| <i>C. wagenitzii</i>    | 1        | 2,0484 | 875       | 6695      | 16535     | 1520      | 7000     | 74        | 174       | 22        | 2100     |
|                         | 2        | 0,3576 | 550       | 1455      | 3750      | 900       | 5000     | 22        | 31        | 14,5      | 200      |
|                         | 3        | 0,6382 | 775       | 1155      | 2865      | 330       | 6250     | 8,5       | 20,5      | 10        | 525      |
| <i>C. tossiensis</i>    | 1        | 0,9056 | 350       | 1310      | 9250      | 350       | 13000    | 38        | 26,5      | 15        | 2350     |
|                         | 2        | 0,4396 | 275       | 1450      | 8455      | 235       | 12500    | 20        | 16,5      | 9         | 1000     |
|                         | 3        | 0,5862 | 350       | 1305      | 10640     | 585       | 11750    | 79,5      | 37,5      | 16,5      | 1100     |
| <i>C. hieropolitana</i> | 1        | 0,9151 | 1050      | 1470      | 9380      | 500       | 10000    | 21,5      | 69,5      | 11        | 250      |
|                         | 2        | 1,2687 | 400       | 6550      | 35005     | 500       | 14500    | 31        | 68,5      | 13        | 750      |
|                         | 3        | 1,592  | 1175      | 1795      | 16575     | 1035      | 9500     | 39        | 53,5      | 6,5       | 525      |
| <i>C. antalyense</i>    | 1        | 1,0647 | 675       | 1435      | 12850     | 1870      | 19500    | 85,5      | 176       | 33,5      | 1850     |
|                         | 2        | 0,8107 | 500       | 1080      | 10400     | 1290      | 10000    | 56        | 29        | 26,5      | 1350     |

**Table 3.** The nutrient elements of species stems

| Species                 | Locality | N<br>% | Na<br>ppm | Mg<br>ppm | Ca<br>ppm | Fe<br>ppm | K<br>ppm | Mn<br>ppm | Zn<br>ppm | Cu<br>ppm | P<br>ppm |
|-------------------------|----------|--------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|----------|
| <i>C. cadmea</i>        | 1        | 1,0048 | 275       | 1215      | 13150     | 445       | 10500    | 24        | 17,5      | 9,5       | 1600     |
|                         | 2        | 1,1763 | 300       | 1040      | 8230      | 270       | 14500    | 106,5     | 19        | 9         | 750      |
|                         | 3        | 0,5922 | 450       | 1340      | 18875     | 2510      | 7250     | 74,5      | 27,5      | 12        | 1600     |
| <i>C. aphrodisea</i>    | 1        | 0,9026 | 500       | 1435      | 11590     | 210       | 9250     | 15        | 18,5      | 5,5       | 1000     |
|                         | 2        | 0,9808 | 300       | 1100      | 9420      | 755       | 12000    | 36,5      | 10        | 6,5       | 250      |
|                         | 3        | 0,5566 | 500       | 930       | 6560      | 160       | 9500     | 20,5      | 24,5      | 10        | 700      |
| <i>C. amaena</i>        | 1        | 1,1115 | 200       | 1005      | 11915     | 145       | 14500    | 23        | 24,5      | 9         | 1250     |
|                         | 1        | 1,6296 | 625       | 1320      | 15790     | 365       | 10500    | 25        | 101       | 125,5     | 1200     |
| <i>C. lycia</i>         | 2        | 1,4202 | 200       | 1155      | 4790      | 375       | 6500     | 18,5      | 83,5      | 11,5      | 300      |
|                         | 3        | 1,5348 | 275       | 1350      | 14070     | 280       | 14000    | 9,5       | 63,5      | 12,5      | 750      |
|                         | 4        | 0,7383 | 550       | 1980      | 22700     | 515       | 8500     | 22        | 16,5      | 7         | 950      |
| <i>C. luschaniana</i>   | 1        | 0,984  | 325       | 1265      | 11850     | 505       | 8750     | 28,5      | 181,5     | 42,5      | 1100     |
|                         | 2        | 0,6869 | 475       | 1145      | 11835     | 385       | 7000     | 29        | 75,5      | 30,5      | 700      |
|                         | 3        | 0,7157 | 250       | 755       | 7525      | 280       | 5500     | 15,5      | 93        | 23        | 650      |
|                         | 4        | 0,325  | 175       | 2330      | 16875     | 210       | 5250     | 13,5      | 20        | 5,5       | 600      |
| <i>C. wagenitzii</i>    | 1        | 1,6964 | 350       | 1340      | 12790     | 575       | 8000     | 30,5      | 177       | 17        | 1050     |
|                         | 2        | 0,5554 | 800       | 2360      | 5715      | 135       | 6250     | 15,5      | 19,5      | 10,5      | 450      |
|                         | 3        | 0,4    | 1300      | 1800      | 4890      | 185       | 7000     | 13        | 12,5      | 9,5       | 525      |
| <i>C. tossiensis</i>    | 1        | 0,9855 | 450       | 1515      | 14515     | 275       | 12000    | 20,5      | 24,5      | 9         | 2950     |
|                         | 2        | 0,646  | 250       | 1380      | 14590     | 75        | 10500    | 7         | 12,5      | 8         | 1350     |
|                         | 3        | 0,8832 | 125       | 1435      | 10315     | 310       | 11250    | 37        | 33,5      | 12,5      | 1350     |
| <i>C. hieropolitana</i> | 1        | 0,7041 | 700       | 2230      | 11620     | 145       | 11250    | 9,5       | 50        | 10        | 700      |
|                         | 2        | 1,1337 | 300       | 6150      | 32445     | 200       | 7000     | 29        | 39,5      | 10,5      | 550      |
|                         | 3        | 1,6449 | 250       | 2180      | 24905     | 240       | 4750     | 17        | 31        | 7         | 950      |
| <i>C. antalyense</i>    | 1        | 0,746  | 325       | 1090      | 8010      | 95        | 18250    | 4,5       | 109,5     | 15        | 850      |
|                         | 2        | 0,5797 | 400       | 620       | 5275      | 75        | 17250    | 3         | 18,5      | 8,5       | 1650     |

Table 4 shows the amount of nutrient elements in the leaves of the species. Almost all the elements are the greater amount of the leaves than the roots and stems. In second

and third sample areas of *C. wagenitzii* have the highest Na (1650-2000 ppm), and third sample area has the highest Mg (14 305 ppm) rates.

**Table 4.** The nutrient elements of species leaves

| Species                 | Locality | N<br>% | Na<br>ppm | Mg<br>ppm | Ca<br>ppm | Fe<br>ppm | K<br>ppm | Mn<br>ppm | Zn<br>ppm | Cu<br>ppm | P<br>ppm |
|-------------------------|----------|--------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|----------|
| <i>C. cadmea</i>        | 1        | 2,0169 | 300       | 3910      | 31270     | 1290      | 23000    | 65        | 37,5      | 21,5      | 2100     |
|                         | 2        | 2,3444 | 225       | 1840      | 17170     | 1110      | 16500    | 237       | 39,5      | 19        | 1700     |
|                         | 3        | 1,1191 | 350       | 1800      | 17505     | 2940      | 20750    | 94,5      | 46        | 26        | 4450     |
| <i>C. aphrodisea</i>    | 1        | 1,3833 | 175       | 2655      | 25140     | 650       | 12500    | 37        | 26        | 7,5       | 700      |
|                         | 2        | 2,2592 | 325       | 3395      | 25045     | 3880      | 15250    | 107,5     | 33        | 14,5      | 750      |
|                         | 3        | 1,1414 | 450       | 1600      | 16635     | 545       | 11000    | 43,5      | 45        | 22        | 950      |
| <i>C. amaena</i>        | 1        | 1,9419 | 225       | 1915      | 28095     | 480       | 15750    | 51        | 55        | 11,5      | 1470     |
|                         | 1        | 2,2657 | 450       | 2310      | 36200     | 2700      | 8750     | 113,5     | 107       | 114,5     | 1300     |
| <i>C. lycia</i>         | 2        | 1,4619 | 500       | 2610      | 11205     | 3165      | 6500     | 118       | 93,5      | 44        | 500      |
|                         | 3        | 2,8814 | 450       | 2515      | 37405     | 3725      | 13750    | 104       | 70        | 49        | 1300     |
|                         | 4        | 1,5095 | 575       | 3860      | 34610     | 1230      | 10000    | 56        | 26,5      | 10,5      | 1050     |
|                         | 1        | 1,4243 | 275       | 1330      | 17055     | 915       | 8750     | 55        | 58,5      | 22,5      | 950      |
| <i>C. luschaniana</i>   | 2        | 1,1122 | 375       | 1365      | 16480     | 855       | 10000    | 61,5      | 40        | 20        | 1050     |
|                         | 3        | 1,3064 | 250       | 1725      | 22455     | 2250      | 11000    | 91,5      | 74,5      | 51,5      | 1100     |
|                         | 4        | 0,4922 | 325       | 5800      | 35340     | 1490      | 5750     | 52        | 28,5      | 10        | 600      |
|                         | 1        | 2,4083 | 625       | 7300      | 23070     | 1280      | 7750     | 96        | 68        | 71        | 600      |
| <i>C. wagenitzii</i>    | 2        | 0,9655 | 1650      | 6655      | 7135      | 445       | 9250     | 25,5      | 25        | 20        | 350      |
|                         | 3        | 0,6426 | 2000      | 14305     | 9890      | 1260      | 8000     | 45,5      | 23,5      | 19,5      | 400      |
|                         | 1        | 2,6647 | 175       | 1855      | 22550     | 1805      | 15250    | 86,5      | 41        | 15        | 3000     |
| <i>C. tossiensis</i>    | 2        | 0,9985 | 225       | 1265      | 16210     | 160       | 13500    | 14,5      | 19,5      | 9,5       | 1250     |
|                         | 3        | 1,8141 | 225       | 6300      | 21430     | 2615      | 17000    | 172,5     | 53        | 29,5      | 1750     |
|                         | 1        | 1,5874 | 450       | 2480      | 23890     | 465       | 15000    | 26        | 34,5      | 10        | 750      |
| <i>C. hieropolitana</i> | 2        | 1,8227 | 275       | 7450      | 38015     | 265       | 9500     | 50,5      | 38,5      | 14        | 1000     |
|                         | 3        | 2,6221 | 325       | 3895      | 27080     | 295       | 8750     | 25        | 34        | 12,5      | 1900     |
|                         | 1        | 1,7396 | 350       | 2115      | 29230     | 490       | 24750    | 35        | 89        | 38,5      | 1900     |
| <i>C. antalyense</i>    | 2        | 1,0479 | 700       | 1955      | 30165     | 4845      | 22000    | 147       | 40        | 17        | 1450     |

### Physical Analysis of Soils

*C. cadmea* prefers sandy-slime type soil, two sample areas of *C. aphrodisea* is sandy-slime type soils and another sample area is slimy sand (Table 5). *C. amaena* is found in sandy-slime soil; slimy-clay, slimy sand, sandy-slime, slime types soils have been observed in localities of *C. lycia*, has large soil type tolerance.

**Table 5.** The physical properties of the soils in the localities of species

| Species r            | Locality | Structure of Soil |        |        | Soil Type    | Color of Soil |              |
|----------------------|----------|-------------------|--------|--------|--------------|---------------|--------------|
|                      |          | Sand %            | Clay % | Dust % |              | Dry           | Wet          |
| <i>C. cadmea</i>     | 1        | 79,33             | 10,62  | 10,05  | Sandy- slime | 2,5 Y – 6/2   | 2,5 Y – 3/2  |
|                      | 2        | 84,9              | 6,23   | 8,82   | Sandy- slime | 2,5 Y – 4/2   | 5 YR – 1,7/1 |
|                      | 3        | 72,4              | 13,44  | 14,16  | Sandy- slime | 10 YR – 6/4   | 10 YR – 4/4  |
| <i>C. aphrodisea</i> | 1        | 76,39             | 14,61  | 9      | Sandy- slime | 10 YR – 5/4   | 5 YR – 2/2   |
|                      | 2        | 89                | 4,2    | 6,8    | Slimy-sand   | 10 YR – 6/4   | 5 YR – 2/2   |
|                      | 3        | 74                | 13,3   | 12,7   | Sandy- slime | 5 YR – 4/3    | 10 R – 2/3   |
| <i>C. amaena</i>     | 1        | 70,9              | 12,8   | 16,3   | Sandy- slime | 7,5 YR-5/3    | 5 YR-2/4     |
|                      | 1        | 41,17             | 41,08  | 17,75  | Slimy-clay   | 5 YR – 5/4    | 5 YR – 3/6   |
| <i>C. lycia</i>      | 2        | 86,31             | 7,5    | 6,18   | Slimy-sand   | 2,5 Y – 5/3   | 10 YR – 3/2  |
|                      | 3        | 76,04             | 9,55   | 14,41  | Sandy- slime | 5 YR - 4/2    | 5 YR – 2/2   |

|                      |   |       |       |       |                     |              |              |
|----------------------|---|-------|-------|-------|---------------------|--------------|--------------|
|                      | 4 | 48,91 | 13,21 | 37,87 | Slime               | 7,5 YR - 4/3 | 7,5 YR - 3/3 |
|                      | 1 | 56,02 | 38,95 | 5,03  | Sandy-clay          | 7,5 YR - 5/4 | 2,5 YR - 2/4 |
| <i>C.</i>            | 2 | 31,23 | 38,51 | 30,25 | Slimy-clay          | 5 YR - 5/6   | 2,5 YR - 3/4 |
| <i>luschaniana</i>   | 3 | 41,47 | 32,35 | 26,17 | Slimy-clay          | 5 YR - 4/4   | 2,5 YR - 2/4 |
|                      | 4 | 43,75 | 33,57 | 22,68 | Slimy-clay          | 7,5 YR - 6/6 | 7,5 YR - 5/8 |
|                      | 1 | 42,57 | 47,12 | 10,31 | Slimy-clay          | 5 YR - 3/6   | 7,5 R - 3/6  |
| <i>C. wagenitzii</i> | 2 | 71,2  | 18,86 | 9,93  | Sandy- slime        | 5 YR - 4/8   | 10 R - 3/4   |
|                      | 3 | 59,71 | 25,45 | 14,84 | Sandy-clay          | 5 YR - 4/6   | 5 YR - 3/6   |
|                      | 1 | 87,91 | 4,03  | 8,06  | Slimy-sand          | 10 YR - 5/2  | 10 YR - 3/1  |
| <i>C. tossiensis</i> | 2 | 48,58 | 39,08 | 12,34 | Slimy-clay          | 10 YR - 5/3  | 10 YR - 3/4  |
|                      | 3 | 72,46 | 15,17 | 12,37 | Sandy-clay<br>Slime | 10 YR - 5/3  | 10 YR - 4/4  |
|                      | 1 | 64,24 | 19,54 | 16,22 | Sandy-clay<br>Slime | 10 YR - 6/3  | 5 YR - 4/3   |
| <i>C.</i>            | 2 | 40,52 | 8,89  | 50,6  | Dusty-slime         | 2,5 Y - 8/2  | 10 YR - 7/2  |
| <i>hieropolitana</i> | 3 | 69,54 | 15,53 | 14,93 | Sandy-clay<br>Slime | 2,5 Y - 7/3  | 7,5 YR - 4/3 |
|                      | 1 | 41,46 | 34,48 | 24,06 | Slimy-clay          | 10 YR - 3/3  | 10 YR - 2/2  |
| <i>C. antalyense</i> | 2 | 38,82 | 38,19 | 22,98 | Slimy-clay          | 7,5 YR - 4/3 | 7,5 YR - 3/4 |

Soil types of distribution areas of *C. luschaniana* are 75% of slimy-clay and 25% sandy clay. *C. wagenitzii* prefers slimy-clay, sandy-slime, and sandy clay type soils. *C. tossiensis* distributes in slimy-sand, slimy-clay, and sandy clay-loam type soils. Two sample areas of *C. hieropolitana* are sandy clay-loam type soils and in the other locality, soil type is dusty slime. Soil type of both two localities of *C. antalyense* is slimy-clay.

Soil type rates of *Phalolepis* section are 30.7% of sandy-slime, 30.7% of slimy-clay, 11.6%, of slimy-sand, 11.6% of sandy clay-loam, 7.8% of sandy-clay, 3.8% of slime and 3.8% of dusty-slime.

### Chemical analysis of soils

Table 6 shows the chemical properties of the soils in the distribution areas of the species. *C. cadmea* spreads in slightly acidic and alkaline soil has large tolerance on the amount of CaCO<sub>3</sub>. Besides, first sample area of *C. cadmea* has the high rate of P<sub>2</sub>O<sub>5</sub>. *C. aphrodisia* prefers neutral and lightly alkaline soil like *C. cadmea* has tolerance to the CaCO<sub>3</sub>. Soil type of distribution area of *C. amaena* is neutral and without lime. *C. lycia* and *C. luschaniana* grow in limestone main rocks, they prefer high lime and alkaline soils. An also fourth sample area of *C. lycia* has the high rate of K. *C. wagenitzii* grows in lightly alkaline soils and localities of the species have the high rate of Mg. *C. tossiensis* has a high tolerance for the soil type, prefers without lime or low lime soils.

*C. hieropolitana* grows on marl, lime, travertine bedrock so prefers alkaline and lime soils. *C. antalyense* prefers neutral, low amounts of lime soils, in the present study first sample area has the high rate of organic compounds.

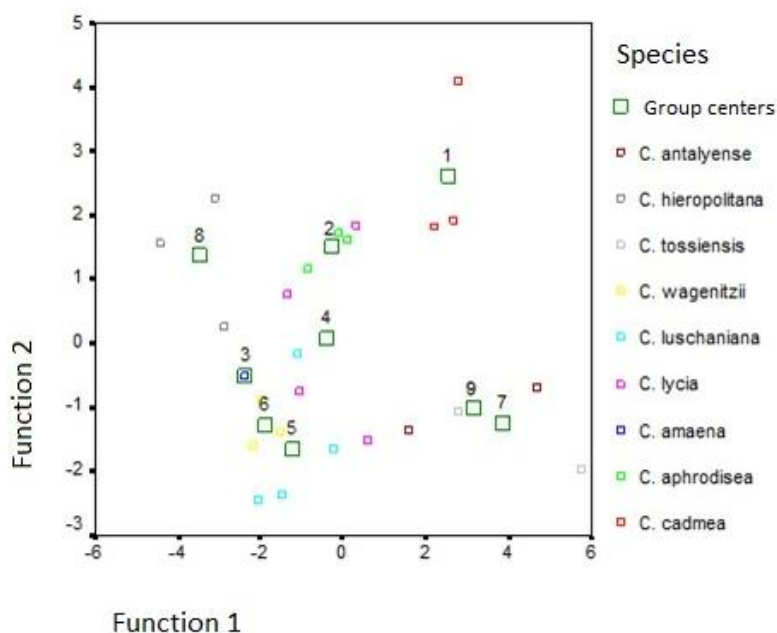
**Table 6.** The chemical properties of soils in the area of distribution of species

| Species                 | Locality | pH<br>1/2,5 | Salt<br>ms/cm | Lime<br>% | Organic<br>% | N<br>% | Na<br>ppm | Mg<br>ppm | Ca<br>ppm | Fe<br>ppm | K<br>ppm | Mn<br>ppm | Zn<br>ppm | Cu<br>ppm | P <sub>2</sub> O <sub>5</sub><br>ppm |
|-------------------------|----------|-------------|---------------|-----------|--------------|--------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|--------------------------------------|
| <i>C. cadmea</i>        | 1        | 8,32        | 0,47          | 0,45      | 1,15         | 0,0186 | 15        | 47        | 3285      | 1,2       | 70       | 6,2       | 1,01      | 0,71      | 82,82                                |
|                         | 2        | 6,52        | 0,32          | 0         | 2,49         | 0,0497 | 30        | 73        | 946       | 1,1       | 51       | 10,3      | 1,01      | 0,2       | 16,16                                |
|                         | 3        | 8,64        | 0,3           | 55,9      | 0            | 0,0489 | 30        | 70        | 7049      | 0,4       | 71       | 6,8       | 1,11      | 0,3       | 5,05                                 |
| <i>C. aphrodisea</i>    | 1        | 7,95        | 0,37          | 0         | 0,98         | 0,028  | 21        | 1751      | 1569      | 1,4       | 93       | 4,8       | 0,82      | 0,21      | 5,15                                 |
|                         | 2        | 7,45        | 0,28          | 0,15      | 0,4          | 0,0113 | 25        | 191       | 1546      | 1,1       | 56       | 5,9       | 1,31      | 0,4       | 16,16                                |
|                         | 3        | 8,59        | 0,24          | 44,5      | 0            | 0,047  | 21        | 2470      | 6586      | 1,3       | 101      | 0,7       | 0,74      | 0,42      | 37,1                                 |
| <i>C. amena</i>         | 1        | 7,36        | 0,47          | 0         | 2,87         | 0,0578 | 31        | 190       | 3005      | 1,1       | 296      | 7,2       | 4,18      | 0,82      | 74,46                                |
| <i>C. lycia</i>         | 1        | 8,26        | 0,41          | 44,5      | 2,02         | 0,2045 | 51        | 204       | 7781      | 0,6       | 416      | 9,4       | 1,13      | 0,93      | 18,54                                |
|                         | 2        | 8,09        | 0,34          | 0,9       | 0            | 0,0644 | 52        | 331       | 5673      | 0,4       | 98       | 6         | 1,13      | 0,62      | 21,63                                |
|                         | 3        | 7,98        | 0,44          | 39,2      | 1,33         | 0,3746 | 21        | 334       | 7631      | 1,2       | 165      | 3,2       | 0,93      | 0,62      | 18,54                                |
|                         | 4        | 8,21        | 0,72          | 25        | 11,33        | 0,5546 | 74        | 366       | 7917      | 1,7       | 1525     | 15,2      | 0,84      | 8,51      | 18,9                                 |
| <i>C. luschaniana</i>   | 1        | 8,23        | 0,29          | 6,96      | 12,07        | 0,4188 | 37        | 581       | 8175      | 0,6       | 783      | 1,3       | 1,07      | 0,75      | 24,61                                |
|                         | 2        | 8,39        | 0,26          | 13,04     | 2,59         | 0,2657 | 37        | 296       | 8055      | 0,9       | 411      | 3,3       | 0,74      | 0,74      | 22,05                                |
|                         | 3        | 8,22        | 0,3           | 10,1      | 3,66         | 0,3265 | 53        | 262       | 8140      | 0,8       | 318      | 2,3       | 0,95      | 0,74      | 19,08                                |
|                         | 4        | 8,64        | 0,4           | 54,4      | 0,93         | 0,036  | 31        | 427       | 7381      | 0,5       | 258      | 0,7       | 0,72      | 10,61     | 27,81                                |
| <i>C. wagenitzii</i>    | 1        | 8,1         | 0,11          | 0         | 1,08         | 0,0201 | 251       | 3019      | 1745      | 0,5       | 238      | 10,2      | 1,16      | 0,65      | 6,45                                 |
|                         | 2        | 7,94        | 0,36          | 0         | 0,58         | 0,0098 | 85        | 2360      | 746       | 0,3       | 97       | 6,6       | 0,91      | 0,34      | 5,7                                  |
|                         | 3        | 8,22        | 0,81          | 0         | 0,28         | 0,0371 | 334       | 2639      | 1310      | 0,7       | 138      | 15,8      | 0,74      | 0,21      | 11,66                                |
| <i>C. tossiensis</i>    | 1        | 8,43        | 0,43          | 5,84      | 1,8          | 0,0693 | 25        | 137       | 6420      | 1         | 55       | 22,1      | 1,14      | 0,61      | 5,05                                 |
|                         | 2        | 6,25        | 0,2           | 0         | 0,27         | 0,1156 | 36        | 244       | 1265      | 0,8       | 98       | 10,7      | 1,01      | 0,62      | 23,69                                |
|                         | 3        | 8,41        | 0,36          | 2,71      | 0,99         | 0,0789 | 26        | 112       | 7434      | 0,8       | 82       | 3,5       | 1,55      | 0,52      | 5,15                                 |
| <i>C. hieropolitana</i> | 1        | 8,22        | 0,39          | 28,4      | 1,27         | 0,177  | 25        | 215       | 6923      | 0,8       | 304      | 0,9       | 1,01      | 0,61      | 23,23                                |
|                         | 2        | 8,68        | 0,49          | 71,9      | 1,59         | 0,0419 | 21        | 214       | 7150      | 1,4       | 57       | 1,4       | 0,94      | 0,73      | 21,84                                |
|                         | 3        | 8,35        | 0,53          | 29,8      | 1,67         | 0,0223 | 32        | 147       | 7239      | 0,6       | 171      | 3,7       | 1,5       | 0,64      | 32,1                                 |
| <i>C. antalyense</i>    | 1        | 7,45        | 0,13          | 2,19      | 12,95        | 0,7206 | 69        | 248       | 8000      | 1,8       | 297      | 16        | 1,38      | 1,17      | 9,54                                 |
|                         | 2        | 7,65        | 0,58          | 0,5       | 1,92         | 0,1943 | 47        | 207       | 6259      | 1,2       | 287      | 5,6       | 1,35      | 0,62      | 16,64                                |



### Statistical Analysis

In the analyses of the amount of the nutrient elements of the roots, the classification success have been found 92.3%. One sample area of *C. aphrodisea* passed to *C. lycia*, one sample area of *C. luschaniana* passed to *C. wagenitzii*, other plant species stayed in their own groups (Fig. 2). First, two discrimination functions include 71,8 % of all variance. In separation analyses of amounts of the nutrient elements of the roots, in the first function Mn, P, Ca and N are the most important variants, and in the second function Ca, Mn, Zn, and P (Table 7).



**Figure 2.** The graphical representation of the discriminant analysis of amount of nutrient element analyses of roots

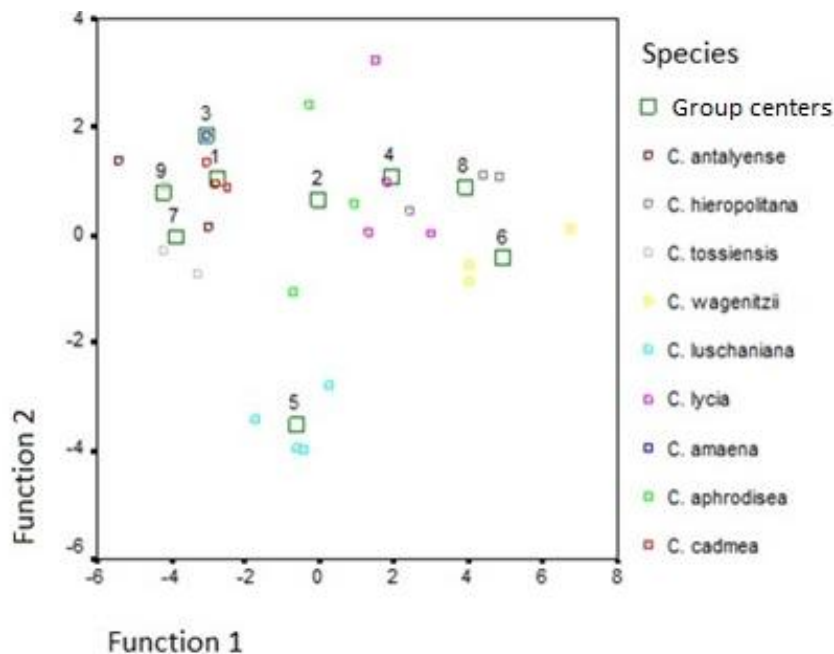
The classification analysis success of amounts of nutrient elements of the stems is 92.3%. One sample area of *C. cadmea* passed to *C. tossiensis*, one sample area of *C. hieropolitana* passed to *C. lycia*, other plant species stayed in their own groups (Fig. 3). First, two functions of Table 8 explain the 77,1% of the variations. In separation analyses of amounts of the nutrient elements of the stems, in the first function Na, N, P, and Cu are the most important variants, and in the second function N, Zn, Fe, and K.

**Table 7.** The results of discrimination of amount of nutrient elements of the roots

| Function | Core value | Variance (%) | Total (%) | Kanon. Korelas | Wilks' Lambda | Khi-Kare | SD | Severity level |
|----------|------------|--------------|-----------|----------------|---------------|----------|----|----------------|
| 1        | 8,408      | 51,7         | 51,7      | ,945           | ,001          | 102,391  | 80 | ,047           |
| 2        | 3,279      | 20,1         | 71,8      | ,875           | ,013          | 67,646   | 63 | ,322           |
| 3        | 2,471      | 15,2         | 87,0      | ,844           | ,054          | 45,113   | 48 | ,592           |
| 4        | ,754       | 4,6          | 91,6      | ,656           | ,189          | 25,823   | 35 | ,871           |
| 5        | ,611       | 3,8          | 95,4      | ,616           | ,332          | 17,113   | 24 | ,844           |
| 6        | ,550       | 3,4          | 98,7      | ,596           | ,534          | 9,720    | 15 | ,837           |
| 7        | ,190       | 1,2          | 99,9      | ,400           | ,828          | 2,925    | 8  | ,939           |
| 8        | ,015       | ,1           | 100,0     | ,120           | ,986          | ,225     | 3  | ,973           |

*Standardized Separation Function Coefficients*

|        | Function |       |       |        |       |       |        |       |
|--------|----------|-------|-------|--------|-------|-------|--------|-------|
|        | 1        | 2     | 3     | 4      | 5     | 6     | 7      | 8     |
| N %    | -1,103   | ,339  | ,113  | -1,010 | ,605  | -,523 | -1,063 | ,009  |
| Na ppm | -,418    | ,329  | -,329 | ,547   | ,417  | ,280  | ,961   | ,063  |
| Mg ppm | ,003     | ,197  | -,470 | ,886   | -,510 | ,314  | ,383   | ,740  |
| Ca ppm | -1,201   | ,626  | ,416  | -,740  | -,288 | ,016  | ,130   | ,125  |
| Fe ppm | -,361    | ,147  | ,085  | ,246   | ,883  | -,243 | -,950  | -,166 |
| K ppm  | 1,099    | ,409  | ,039  | ,298   | ,003  | ,849  | -,258  | -,008 |
| Mn ppm | 1,457    | ,599  | -,017 | ,676   | -,470 | -,080 | 1,078  | -,116 |
| Zn ppm | -,660    | -,530 | ,365  | ,009   | -,268 | ,243  | -,054  | -,164 |
| Cu ppm | -,106    | -,347 | ,892  | ,179   | ,093  | ,130  | -,018  | ,307  |
| P ppm  | 1,431    | -,504 | -,595 | -,324  | ,212  | -,507 | ,497   | ,346  |



**Figure 3.** The graphical representation of the discriminant analysis of amount of nutrient element analyses of stems

**Table 8.** The discriminate analysis results of amount of nutrient element analyses of stems

| Function | Core value | Variance (%) | Total (%) | Kanon. Korelas | Wilks' Lambda | Khi-Kare | SD | Severity level |
|----------|------------|--------------|-----------|----------------|---------------|----------|----|----------------|
| 1        | 14,596     | 60,8         | 60,8      | ,967           | ,000          | 118,585  | 80 | ,003           |
| 2        | 3,927      | 16,3         | 77,1      | ,893           | ,007          | 76,006   | 63 | ,126           |
| 3        | 2,652      | 11,0         | 88,2      | ,852           | ,037          | 51,289   | 48 | ,346           |
| 4        | 1,198      | 5,0          | 93,1      | ,738           | ,133          | 31,213   | 35 | ,652           |
| 5        | 1,096      | 4,6          | 97,7      | ,723           | ,293          | 19,004   | 24 | ,752           |
| 6        | ,359       | 1,5          | 99,2      | ,514           | ,615          | 7,534    | 15 | ,941           |
| 7        | ,173       | ,7           | 99,9      | ,384           | ,836          | 2,785    | 8  | ,947           |
| 8        | ,020       | ,1           | 100,0     | ,140           | ,980          | ,307     | 3  | ,959           |

Standardized Separation Function Coefficients

|        | Function |        |       |       |       |       |      |       |
|--------|----------|--------|-------|-------|-------|-------|------|-------|
|        | 1        | 2      | 3     | 4     | 5     | 6     | 7    | 8     |
| N %    | 1,764    | 1,565  | ,217  | ,031  | -,016 | -,553 | ,054 | -,243 |
| Na ppm | 1,834    | ,444   | ,144  | ,602  | ,123  | ,082  | ,225 | -,191 |
| Mg ppm | ,486     | ,433   | ,040  | ,199  | ,835  | ,151  | ,142 | ,614  |
| Ca ppm | ,160     | -,244  | -,294 | -,844 | -,368 | ,518  | ,106 | -,501 |
| Fe ppm | ,060     | ,873   | ,059  | ,303  | -,445 | ,127  | ,177 | ,772  |
| K ppm  | -,648    | ,789   | -,598 | ,164  | -,118 | ,420  | ,172 | ,006  |
| Mn ppm | -,425    | -,337  | ,969  | ,010  | ,051  | ,257  | ,106 | -,410 |
| Zn ppm | ,336     | -1,271 | -,320 | ,345  | ,270  | ,532  | ,591 | -,432 |
| Cu ppm | -,649    | -,184  | -,227 | -,480 | -,534 | -,405 | ,272 | ,607  |
| P ppm  | -1,017   | -,137  | ,431  | ,128  | ,865  | -,438 | ,269 | ,070  |

The classification analysis success of amounts of nutrient elements of the leaves have been found 88.5%. One sample area of *C. aphrodisea* passed to *C. luschaniana*, one sample area of *C. luschaniana* and *C. hieropolitana* passed to *C. aphrodisea*, other plant species stayed in their own groups (Fig. 4).

First, two separation functions explain the 85,3% of all variations. In the first function Mn, N, K and Cu, in the second function Zn, Cu, Ca and Mg have provided the biggest contribution (Table 9).

The discrimination analysis success of chemical and physical soil (0-10 cm) contents of the species is 96.2%. One sample area of *C. hieropolitana* passed to *C. lycia*, other plant species stayed in their own groups (Fig. 5).

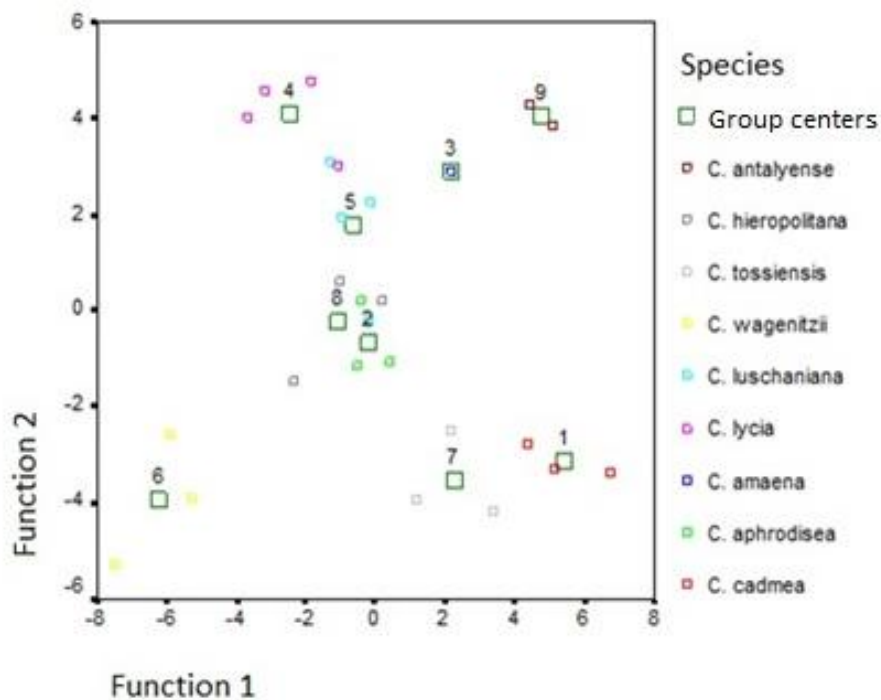


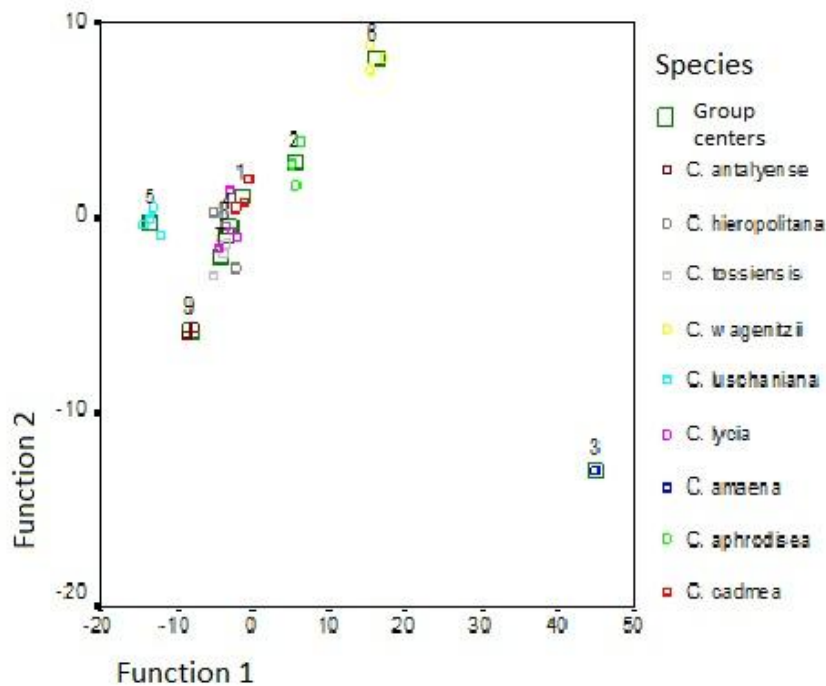
Figure 4. The graphical representation of the discriminant analysis of amount of nutrient element analyses of leaves

**Table 9.** The discriminate analysis results of amount of nutrient element analyses of leaves

| Function | Core value | Variance (%) | Total(%) | Kanon. Korelas | Wilks' Lambda | Khi-Kare | SD | Severity level |
|----------|------------|--------------|----------|----------------|---------------|----------|----|----------------|
| 1        | 17,631     | 47,7         | 47,7     | ,973           | ,000          | 133,598  | 80 | ,000           |
| 2        | 13,893     | 37,6         | 85,3     | ,966           | ,003          | 88,264   | 63 | ,020           |
| 3        | 3,488      | 9,4          | 94,8     | ,882           | ,050          | 46,400   | 48 | ,539           |
| 4        | ,821       | 2,2          | 97,0     | ,671           | ,225          | 23,127   | 35 | ,938           |
| 5        | ,698       | 1,9          | 98,9     | ,641           | ,410          | 13,838   | 24 | ,950           |
| 6        | ,331       | ,9           | 99,8     | ,499           | ,695          | 5,634    | 15 | ,985           |
| 7        | ,044       | ,1           | 99,9     | ,204           | ,925          | 1,200    | 8  | ,997           |
| 8        | ,035       | ,1           | 100,0    | ,185           | ,966          | ,540     | 3  | ,910           |

*Standardized Separation Function Coefficients*

|        | Function |        |       |        |       |       |       |       |
|--------|----------|--------|-------|--------|-------|-------|-------|-------|
|        | 1        | 2      | 3     | 4      | 5     | 6     | 7     | 8     |
| N %    | -1,026   | -,756  | -,010 | ,684   | ,215  | ,899  | ,275  | -,305 |
| Na ppm | -,640    | 1,342  | 1,297 | ,193   | ,415  | -,119 | -,283 | -,486 |
| Mg ppm | -,297    | -1,766 | -,199 | ,212   | -,212 | -,074 | ,398  | ,739  |
| Ca ppm | ,315     | 2,504  | ,537  | ,364   | ,559  | -,275 | -,705 | ,076  |
| Fe ppm | -,620    | ,311   | -,510 | -,412  | -,570 | ,751  | ,264  | ,532  |
| K ppm  | ,923     | -,519  | ,459  | ,096   | -,493 | ,134  | ,008  | ,058  |
| Mn ppm | 1,177    | ,240   | ,610  | -,341  | ,715  | -,462 | -,378 | -,594 |
| Zn ppm | ,276     | 3,350  | ,655  | ,683   | ,262  | -,696 | 1,032 | -,033 |
| Cu ppm | -,739    | -2,700 | -,039 | -1,064 | -,222 | ,513  | -,606 | ,326  |
| P ppm  | ,654     | -,332  | ,123  | -,065  | ,831  | -,276 | ,061  | ,211  |



**Figure 5.** The graphical representation of the discriminant analysis of chemical and physical properties of the soils (0-10 cm) of the distribution localities of the species

First, two separation functions explain the 92,4% of all variations. In the first function  $\text{Ca}^{++}$ , N, the organic compound, and  $\text{Zn}^{++}$ , in the second function  $\text{Ca}^{++}$ , pH, sand and K amounts are important (Table 10).

**Table 10.** The discriminate analysis results of chemical and physical properties of the soils (0-10 cm) of the distribution localities of the species

| Function | Core value | Variance (%) | Total(%) | Kanon. Korelas | Wilks' Lambda | Khi-Kare | SD  | Severity level |
|----------|------------|--------------|----------|----------------|---------------|----------|-----|----------------|
| 1        | 227,09     | 82,0         | 82,0     | ,998           | ,000          | 194,444  | 128 | ,000           |
| 2        | 28,653     | 10,4         | 92,4     | ,983           | ,000          | 126,572  | 105 | ,075           |
| 3        | 13,331     | 4,8          | 97,2     | ,964           | ,001          | 84,202   | 84  | ,473           |
| 4        | 4,121      | 1,5          | 98,7     | ,897           | ,017          | 50,922   | 65  | ,899           |
| 5        | 1,635      | ,6           | 99,3     | ,788           | ,087          | 30,505   | 48  | ,977           |
| 6        | 1,063      | ,4           | 99,7     | ,718           | ,230          | 18,394   | 33  | ,981           |
| 7        | ,563       | ,2           | 99,9     | ,600           | ,474          | 9,344    | 20  | ,979           |
| 8        | ,351       | ,1           | 100,0    | ,510           | ,740          | 3,762    | 9   | ,926           |

#### Standardized Separation Function Coefficients

|                        | Function |        |        |        |        |        |       |        |
|------------------------|----------|--------|--------|--------|--------|--------|-------|--------|
|                        | 1        | 2      | 3      | 4      | 5      | 6      | 7     | 8      |
| pH                     | 2,652    | 1,691  | ,088   | ,043   | -,326  | ,323   | -,488 | ,807   |
| Salt                   | -,060    | -,822  | -1,109 | -,166  | -,021  | ,023   | ,700  | ,007   |
| Lime                   | 2,823    | ,508   | 1,788  | ,688   | ,043   | ,188   | ,539  | ,547   |
| Dust                   | 1,913    | ,441   | -,954  | 1,552  | -,010  | -,495  | ,282  | -,748  |
| Sand                   | 2,334    | ,942   | 1,156  | 1,073  | ,466   | ,055   | ,109  | -,288  |
| Org. comp.             | -3,724   | ,004   | -,614  | ,141   | -1,787 | -1,107 | ,229  | ,204   |
| N                      | 3,976    | ,400   | -1,523 | ,643   | 1,132  | 1,045  | ,089  | 1,082  |
| $\text{Na}^+$          | -,033    | ,826   | ,322   | ,496   | -,100  | -,089  | ,186  | ,252   |
| $\text{Mg}^{++}$       | 2,409    | ,121   | -,827  | -,314  | ,051   | ,219   | ,074  | -,414  |
| $\text{Ca}^{++}$       | -5,822   | -2,083 | -,480  | -,491  | ,207   | -,234  | ,189  | -1,191 |
| $\text{Fe}^{++}$       | -,739    | -,744  | 1,847  | -1,637 | -,465  | ,510   | ,187  | ,230   |
| $\text{K}^+$           | 2,098    | ,932   | 2,160  | ,702   | ,831   | ,740   | -,352 | -,441  |
| $\text{Mn}^{++}$       | 1,003    | -,421  | -,164  | -,313  | ,904   | -,616  | -,040 | -,117  |
| $\text{Zn}^{++}$       | 3,232    | -,855  | -,260  | -,054  | -,006  | ,128   | -,001 | -,057  |
| $\text{Cu}^{++}$       | -1,042   | -,507  | -1,096 | -,379  | ,060   | ,256   | -,579 | ,041   |
| $\text{P}_2\text{O}_5$ | ,481     | -,178  | ,133   | ,830   | ,075   | -,238  | -,240 | ,342   |

## Conclusion

Because of limited distribution areas, population of these species are under risk of being extinct. Having narrow habitat let species in *Phalolepis* section be damaged by any natural or antropogenic activity. Tourism activities (Saklıkent, Termessos), agriculture, road construction, grazing and building activities in the region are the most dangerous activities for future of these species populations. Conservation strategies must be performed immediately for species.

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