# ECOLOGICAL STUDY OF NICHE DIFFERENTIATION IN TEN PLANT SPECIES.

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## ABSTRACT

Investigation of niche differentiation of ten wild plant species have been showed a little sign of separation between ten species of nine soil characteristics axes. The separation only by random samples (vegetation vacancy) from the target species, in case of EC and $Ca^{++}$. But in term of pH and $K^{+}$ there was only 10% separation between target species. Concluding that niche differentiation between target species is not sufficient to interpret plants coexisting, might be because all plants need the same requirements of water, light, carbon dioxide, and nutrition elements.

## INTRODUCTION

Niche is the unique way of ecological factors to which an organism is best adapted (Ackerly, 2004; Voorde *et al.*, 2011). All of the environmental conditions are necessary for an organism to maintain available population, and the amount of each resource required to do so. The ecological niche is therefore a characteristic of an organism, or by extension a characteristic species (Gross *et al.* 2007; Law *et al.*, 2009).

The apparent successes of niche differentiation in explaining coexisting in animals communities, can be explained in part by their mobility, but more important by the diversity of food available to them (Begon *et al.*, 1990; Schneider and Illian 2006).

Plant ecologist have had a long-standing interest in the conditions under which species coexist with communities. Many aspect of plant coexisting remain unresolved (Mahdi, 1988 ; Mahdi *et al.*, 1989; Mommor *et al.*, 2010). Several axes has been used in this study to determine the niche of ten target species, precluded statistical analysis, whether the amount of niche separation is compatible

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with observed number of species (Auebrach and Shimida 1993; Coomes *et al*., 2002).

## MATERIALS AND METHODS

### Site and Species:

The site understudy was semi-natural community, located between Agriculture College, and Education Sport College, University of Diyala, which about 20 x 50m. The study was carried out in spring / March 2010. Six soil samples were obtained from beneath of each the ten target species. The soil sample was immediately adjacent to the root of the target species. The plants (target species) were chosen because they were relatively abundant and common species plants in the area. The species are: *Anagallis arvensis (Aa), Atriplex campanulate (Ac), Cardaria draba (Cdr), Cynodon dactylon (Cd), Lactuca serriola (Ls), Malva paryuflora (Mp), Imperata cylindrical (Ic), phalaris minor (Pm), Salsola kali (Sk), Silybum marianum (Sm),* as well as random samples (r), were taken from vacancy between individual plants.

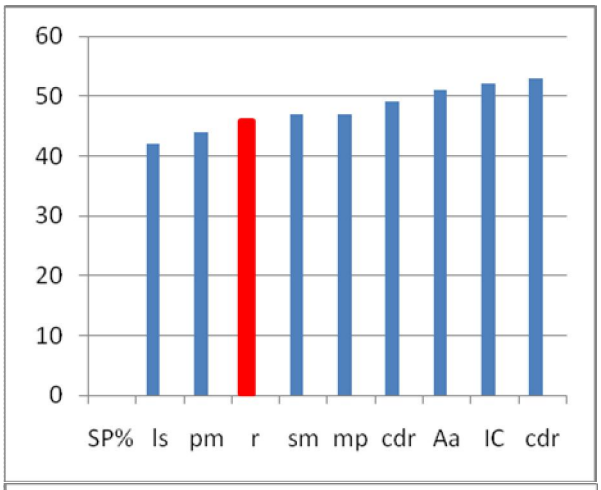
The procedure for taking samples soil was as follows: The cylindrical core had a cutting edge and was of 3.5 cm diameter (11 $cm^2$ area) with 15 cm depth.

### Soil analysis

Each of the soil sample was spread out in the laboratory to be dried, and then sieved. Part of the soil was used to measure pH values by pH meter, and EC by Electrical Conductivity set, then the same sample was used to measure saturation percentage (SP%) and field capacity (FC%). The other part of soil sample was used for the determination of $Na^+$, $Ca^{++}$, $K^+$, $Cl^-$ and $Mg^{++}$, by atomic absorption as described by Allen *et al*. (1974) ; Moor and Chapman (1986).

## RESULTS AND DISCUSSION

AS in Fig. 1, the soil characteristics showed the following values: For EC *Silybum marianum* and random samples fall at two endings average (0.92 – 7.76) $ds.m^{-1}$. Whereas pH (7.72 – 8.45), in contras situation random samples first and *S. marianum* in the end. In most of characteristics, $K^+$, EC, $Na^+$, $Mg^{++}$, and $Ca^{++}$ random samples placed in the end of maximum values. Whereas in case of FC, $Cl^-$ and SP (Saturation percentage) characteristics the position of random samples is about in the middle values.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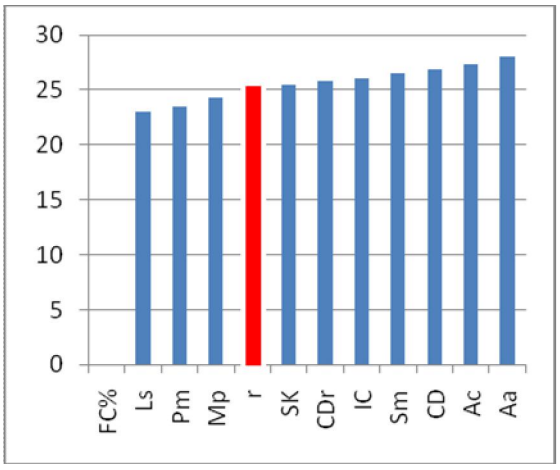
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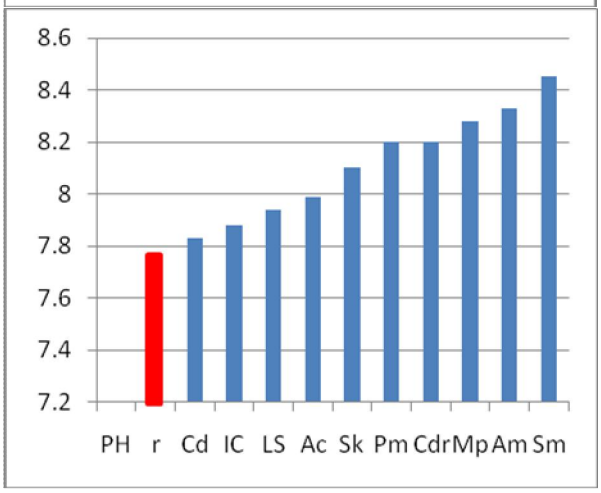
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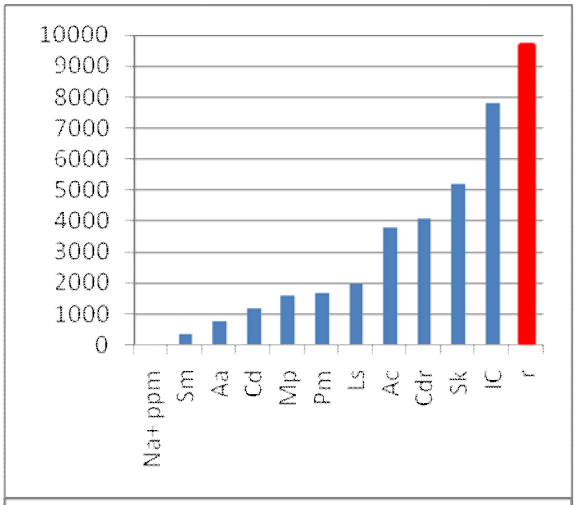
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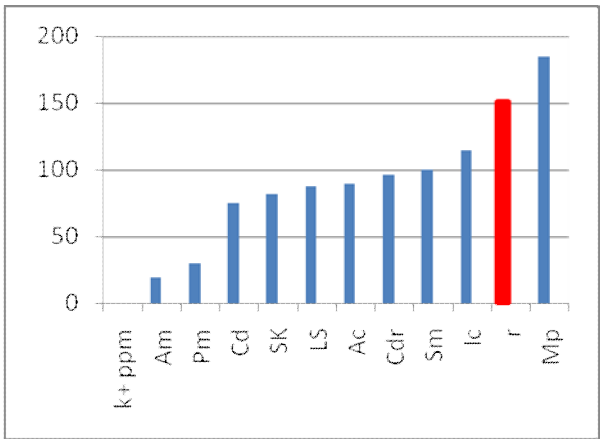
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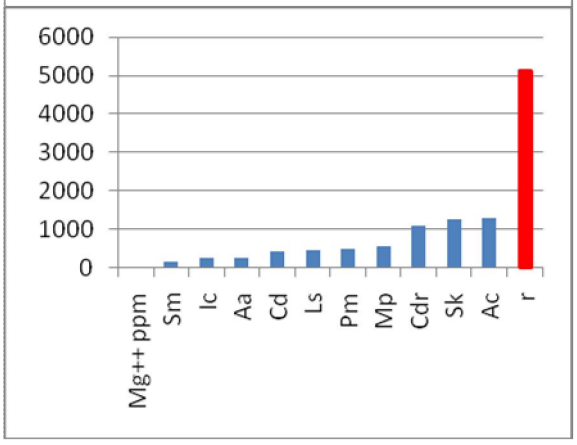
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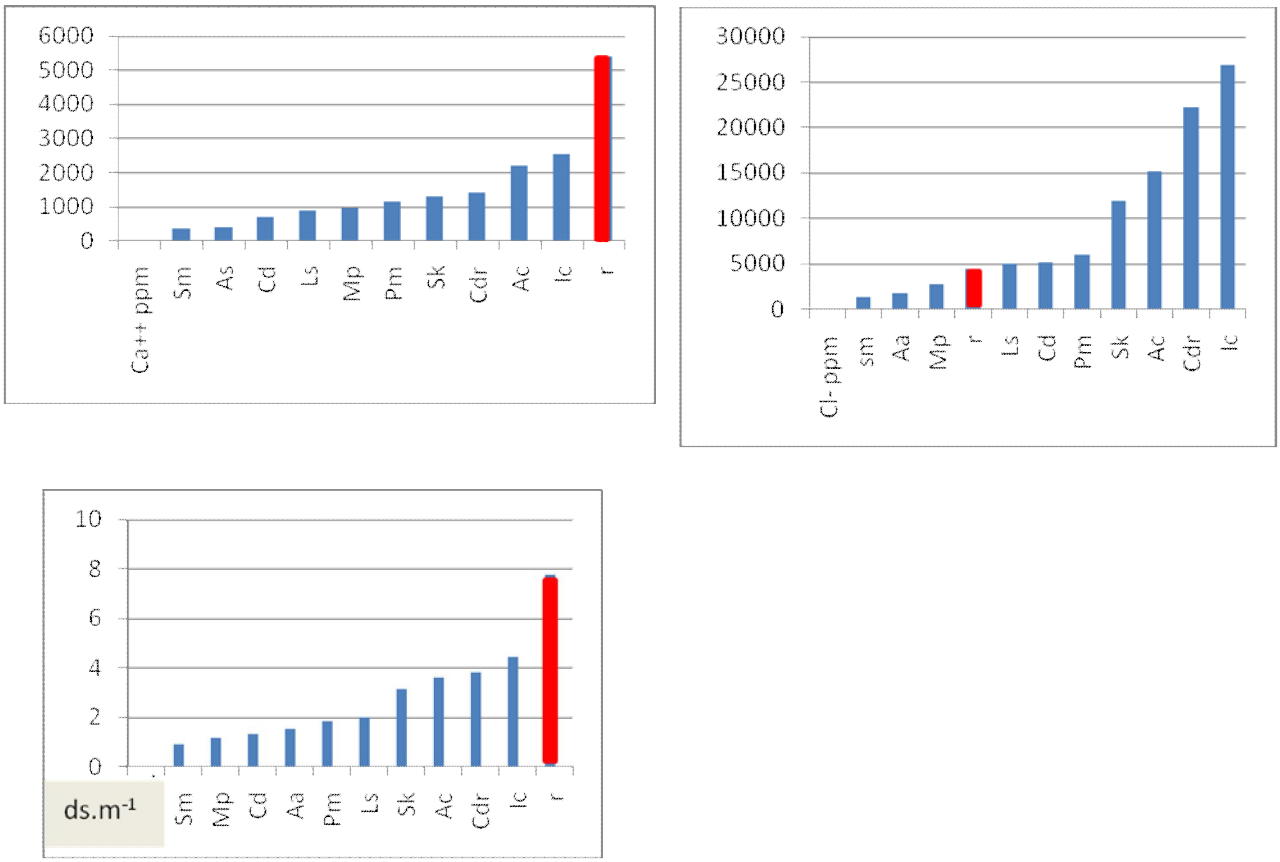


**Fig. 1**. *Mean of pH values, SP% (Saturation percentage), FC (Field Capacity), $Cl^-$ ppm, $K^+$ ppm, EC (Elecrical conductivity) $ds.m^{-1}$, $Na^+$ ppm, $Mg^{++}$ ppm and $Ca^{++}$ ppm of ten species & random sample. The symbols of species are refer to scientific names.*

One way analysis of variance shows that only EC and pH values were significant at $p<0.001$. Whereas $K^+$ and $Ca^{++}$ values were significant at $p<0.05$ (Table 1).

**Table 1.** *One-way analysis of variance*.

| Variables | F values |
|---|---|
| Saturation percentage (SP %) | 1.44 ns |
| Field Capacity (FC %) | 0.76 ns |
| Electrical Conductivity (EC $ds.m^{-1}$) | 4.21 *** |
| pH | 3.24 *** |
| $Na^{+}$ (ppm) | 1.57 ns |
| $K^{+}$ (ppm) | 2.22* |
| $Mg^{++}$ (ppm) | 1.80 ns |
| $Ca^{++}$ (ppm) | 2.30* |
| $Cl^{-}$ (ppm) | 0.54 ns |

ns refer to non-significance. ***** represent to $p<0.05$. ******* represent $p<0.001$

Total d.f. = 65.

GT2 multiple comparison test (Sokal & Rolf 1981) separated only random samples from other species in EC (Table 2), and $Ca^{++}$ (Table 3). In pH values, the separation of *Phalaris minor, Cardaria draba, Malva parviflora, Anagallis arvensis* and *Silybum marianum* from random samples and *Cynodon dactylon*, then *Imperata cylindrical* from *S. marianum* (Table 4). In term of $K^{+}$ separation were *Malva parviflora* from *Anagallis arvensis, Phalaris minor, Cynodon dactylon, Salsola kali* and *Lactuca serriola,* separation of random samples from *Anagallis arvensis* and *Phalaris minor*. finely separation *Imperata cylinderica* from *Anagallis arvensis* (Table 5).

**Table 2.** *GT2 Multiple comparison of EC (Electrical Conductivity) ds.m$^{-1}$.*

| Species | *Sm* | *Mp* | *Cd* | *Aa* | *Pm* | *Ls* | *Sk* | *Ae* | *Cdr* | *Ic* | r |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *S. marianum* | | | | | | | | | | | |
| *M.parviflora* | 0.29 | | | | | | | | | | |
| *C.dactylon* | 0.43 | 0.14 | | | | | | | | | |
| *A.arvensis* | 0.68 | 0.39 | 0.25 | | | | | | | | |
| *P.minor* | 0.69 | 0.40 | 0.01 | 0.01 | | | | | | | |
| *L.serriola* | 0.80 | 0.51 | 0.36 | 0.12 | 0.11 | | | | | | |
| *S.kali* | 2.14 | 1.85 | 1.71 | 1.47 | 1.46 | 1.35 | | | | | |
| *A.campanulat* | 2.61 | 2.32 | 2.18 | 1.93 | 1.92 | 1.81 | 0.47 | | | | |
| *C.draba* | 2.84 | 2.55 | 2.41 | 2.16 | 2.16 | 2.05 | 0.70 | 0.23 | | | |
| *I.cylindrica* | 3.94 | 3.65 | 3.51 | 3.26 | 3.25 | 3.14 | 1.80 | 1.33 | 1.10 | | |
| *R. samples* | 6.84* | 6.55* | 6.41* | 6.16* | 6.16* | 6.05* | 4.70* | 4.23* | 4.00 | 2.90 | |

$ms_e$ = 8.92 (mean square error from analysis of variance).

MSD = (minimum significant difference). = $m_{x(k \& v)}$. $(S^2)^{1/2}$

Where m = 3.5 (from Sokal & Rolf (1981), Table 21. x is the probability = 0.05, k is d.f = 11 - 1 = 10, $S^2 = ms_e/n = 8.92/6 = 1.487$

MSD = 3.4 x $(1.487)^{1/2}$ = 3.4 x 1.22 = 4.15

All the values in the Table, bigger than (4.15) are significant different at p=0.05 level. Table of $\overline{X}_i - \overline{X}_j$ (in rank order of increasing means).

**Table 3**. *GT2 Multiple comparison test of* $Ca^{++}$ *ppm.*

| Species | *Sm* | *Mp* | *Cd* | *Aa* | *Pm* | *Ls* | *Sk* | *Ae* | *Cdr* | *Ic* | *r* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *S.marianum* | | | | | | | | | | | |
| *A.arvensis* | 71 | | | | | | | | | | |
| *C.dactylon* | 342 | 271 | | | | | | | | | |
| *L.serriola* | 520 | 520 | 178 | | | | | | | | |
| *M.parviflora* | 542 | 471 | 200 | 22 | | | | | | | |
| *P.minor* | 750 | 679 | 408 | 230 | 208 | | | | | | |
| *S.kali* | 1006 | 935 | 664 | 486 | 464 | 256 | | | | | |
| *C.draba* | 1025 | 954 | 683 | 505 | 483 | 275 | 19 | | | | |
| *A.campan.* | 1834 | 1763 | 1492 | 1314 | 1292 | 1084 | 828 | 809 | | | |
| *I.cylindrica* | 2176 | 2105 | 1834 | 1656 | 1534 | 1426 | 1170 | 1151 | 342 | | |
| *R.samples* | 5133* | 5062* | 4791* | 4613* | 4591* | 4383* | 4127* | 4108* | 3299* | 2957* | |

$Ms_e$ = 4283165, $S^2$ = 4283165/6 = 713860.83

MSD = 3.4 X $(713860.83)^{1/2}$ = 3.4 X 844.9 = 2873

Table of $\bar{X}_i - \bar{X}_j$ (in rank order of increasing means).

**Table 4.** GT2. Multiple comparison test of pH.

| Species r | *Cd* | *Ic* | *Ls* | *Ac* | *Sk* | *Pm* | *Cdr* | *Mp* | *Aa* *Sm* |
|---|---|---|---|---|---|---|---|---|---|
| R. samples | | | | | | | | | |
| *C.dactylon* 0.05 | | | | | | | | | |
| *I.cylindrica* 0.30 | 0.25 | | | | | | | | |
| *L.serriola* 0.34 | 0.29 | 0.04 | | | | | | | |
| *A.campan.* 0.35 | 0.29 | 0.04 | 0.01 | | | | | | |
| *S.Kali* 0.40 | 0.34 | 0.10 | 0.06 | 0.05 | | | | | |
| *P.minor* 0.51* | 0.46* | 0.21 | 0.17 | 0.17 | 012 | | | | |
| *C.draba* 0.50* | 0.46* | 0.21 | 0.18 | 0.17 | 0.12 | 0.01 | | | |
| *M.parviflor* 0.54* | 0.49* | 0.24 | 0.20 | 0.19 | 0.14 | 0.03 | 0.03 | | |
| *A.arvensis* 0.54* | 0.49* | 0.24 | 0.20 | 0.20 | 0.14 | 0.03 | 0.03 | 0.01 | |
| *S.marianum* 0.73* | 0.68* | 0.43* | 0.39 | 0.38 | 0.33 | 0.22 | 0.19 | 0.19 | 0.19 |

$Ms_e$ = 0.0864, $S^2$ = 0.0864/6 = 0.0144

MSD = 3.2 x $(0.0144)^{1/2}$ = 3.4 x 0.12 = 041

Table of $\bar{X_j}$ - $\bar{X_j}$ (in order of increasing means).

**Table 5.** *GT2 Multiple comparison test of* $K^+$ *ppm.*

| Species | *Aa* | *Pm* | *Cd* | *Sk* | *Ls* | *Ac* | *Cdr* | *Sm* | r *Mp* |
|---|---|---|---|---|---|---|---|---|---|
| *A.arvensis* | | | | | | | | | |
| *P.minor* | 12.5 | | | | | | | | |
| *C.dactylon* | 55.3 | 42.8 | | | | | | | |
| *S.kali* | 59.8 | 47.3 | 4.5 | | | | | | |
| *L.Serriola* | 60.2 | 47.7 | 4.9 | 0.4 | | | | | |
| *A.campan.* | 74.2 | 61.7 | 18.9 | 14.4 | 14.0 | | | | |
| *C.draba* | 86.5 | 74.0 | 31.2 | 26.7 | 26.3 | 12.3 | | | |
| *S.marianum* | 88.3 | 75.8 | 33.0 | 28.5 | 28.1 | 14.1 | 1.8 | | |
| *I.cylindrica* | 98.7* | 86.2* | 43.4 | 38.9 | 38.5 | 24.1 | 12.2 | 10.4 | |
| *R.samples* | 117.0* | 104.5* | 61.7 | 57.2 | 56.8 | 42.8 | 30.5 | 28.7 | 18.3 |
| *M.parviflo.* | 164.5* | 152.0* | 109.2* | 104.7* | 90.3 | 78.0 | 76.2 | 65.8 | 65.8 | 74.5 |

$Ms_e = 4973$, $S^2 = 4973/6 = 828.83$

$MSD = 3.4 \times (828.83)^{1/2} = 3.4 \times 28.79 = 97.88$

The average of soil characteristics (Fig. 1) showed moderate value of saturation percentage (SP %), field capacity (FC %), $Ca^{++}$, and $Mg^{++}$. The pH values tend to be alkaline, this is the attribute to nature of semi-desert soil regions (Grime 1990; Bolker *et al*. 2003). Whereas relatively high values of $Cl^-$, $Na^+$, & EC, but $K^+$ was very low values.

The effect of vegetation seems to be increased (Mahdi *et al.* 1990; Law and Dieckmann 2000) comparing with random samples. In case of $K^+$, $Na^+$, and $Mg^{++}$ the effect was in decreased comparing with random samples, because the consumption of nutrition elements. In term of EC, the vegetation decreased

evaporation from the soil, thus the salinity on its surface was decreased (Yodzis 1986; Murrell and Law 2003).

One-way analysis of variance among species confirms that there is a lack at separation of SP%, FC%, $Na^+$ , $Mg^{++}$, and $Cl^-$ . In terms of $K^+$ and pH there were little niche separation, being only 13% (Excluded random Samples).

The results show that there is little niche separation between species. In view of the major concept of niche theory that two (or more) competing species cannot coexist in the same niche (Hardin 1960). This study may be regard the theory is inappropriate to applied on the plant species (Mahdi *et al.* 1989; Voorde *et al.* 2011). Although niche differentiation can never be completely eliminated as a possible mechanism for coexistence. It is therefore concluded that niche differentiation is unlikely to play a major role in the coexisting of plants species. The coexisting of animals can easily be explain in terms of 350,000 species of plants as available food for animals, no comparable explanation for autotrophic plants, which they all need light, carbon dioxide, water and the same minerals nutrients (Aarssen 1983; Fajardo & Mclntire 2011).

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## دراسة بيئية عن تمايز ألمركز ألبيئي في عشرة أنواع نباتية .

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### الخلاصة

دراسة التمايز ألبيئي لعشرة أنواع نباتية برية، أظهرت قليل من الفصل فيما بينها لتسعة صفات تربة تنموا عليها. ألفصل كان فقط للعينات العشوائية (والتي أخذت من ألفراغات بين ألنباتات تحت ألدراسة) لصفتي ألتوصيل ألكهربائي و عنصر ألكالسيوم. لكن في حالة ألرقم ألهيدروجيني و عنصر البوتاسيوم، هناك فقط عشرة بالمائة فصل بين النباتات تحت ألدراسة. أما بقية صفات ألتربة ألأخرى فلم تظهر إي فصل فيما بينها. نستنتج إن تمايز ألمركز ألبيئي بين ألنباتات ليس كافياً لتفسير ألتعايش بين للنباتات تحت الدراسة. وهذا يعود لسبب إن ألنباتات لها نفس ألاحتياجات من ألماء و ألضوء وثاني أوكسيد ألكربون

والمغذيات المعدنية .