Amendment Of Cations And Ions In The Soil Of Semi-Arid Areas Under By Halophytes Plant Cultivation.

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Received: 11/07/2023 **Accepted:** 15/11/2023

Abstract:
The problem of agricultural soil salinity resulting from environmental factors and excessive use in semi-arid areas, and finding biological and ecological solutions in this area are limited.
This work is the subject of a study of the possibility of phytodesalination of the saline soils of the North Tébessa region (Morsott, El-Aouinet, Boukhadra), by the planting of two halophyte species, a local (Atriplex hilumus) and the other Australian (Atriplex nummularia) in different salinity environments.
We chose four different zones according to the salinity, Then we proceeded to the culture of the Atriplex plants. halimus and nummularia, which were obtained from the High Commission for Steppe Development (H.C.D.S), Tebessa. After two to six months of planting, we took soil samples adhering to the roots of the shrubs (Rizosphere), and the surrounding soil (control).
The results of analysis of the samples were compared between the soils of the two halophytic plants and the control soil, which showed that the application of Atriplex. halimus and nummularia produces a decrease of cations and anions and thus a decrease of the electrical conductivity (EC) with the opposite event of the low salinity region,
this is due to the phenomenon of osmotic adjustment of ions between plant roots and soil, and Atriplex's preference for saline environments.

Key words: cationa, anion, Atriplex halimus, Atriplex numularia, Soil

1-INTRODUCTION

In this topic, there is a good presentation of the salinity of the northern region of the Tébessa-Morsot collapse, located between two municipalities (Morsot and El Aouinet) and characterized by a strong demographic and agricultural dynamics. The region will be a pole of development of the two communes for the next decades, classified steppe zone extending on the semi-arid climatic stage (300 to 400 mm), it is dominated by a particular vegetation such as mugwort (Artemisia herba alba), Alfa (Stipa tenacissima), Sparte (Lygeum spartum) and Atriplex halimus (FAO .2010).
for the rehabilitation of saline soils. The ideal choice of suitable vegetation for these conditions is the first step in solving the problem of salinity. Thus, the introduction of halophilic species that complete their life cycles to high salinity levels and have the ability to accumulate high concentrations of micronutrients above normal levels (Wang and al .1997) are promising for soil desalination in arid and semi-arid zones (Messedi and Abdelly . 2004).
Halophytes, plants adapted to severe salinities, represent one of these groups of plants, which constitute a fundamental multi-interest phytoressource. Thus, certain halophytes related to the glycophyte *Atriplex* model were selected.
The advantages of using these species, especially *Atriplex*, are ecophysiological adaptation strategies, their high resistance to aridity and salinity (Belkhodja and Bidai .2004).
The highly branched *Atriplex* root systems play an important role in the rehabilitation of degraded soils and the fight against soil erosion and desertification (Abbad and al . 2004). Forage planting techniques use exotic species such as *Medicago arborea, Opuntia ficus indica, Atriplex nummularia* and *Atriplex canescens.* for the fight against desertification, where the fodder plantations component has restored degraded rangelands.
The approach adopted is based on the synchronic study comparing planted soils of the two species of *Atriplex* and a control soil, all four perimeters have been defended for four years. The goal is to determine the effects of plantations on some physico-chemical parameters of the soil.

2- MATERIAL AND METHOD

2 -1- CHOOSING PLANTING AREAS

The study area belonging to the semi-arid bioclimatic stage was hot and dry characterized by a summer drought, four plots of plantation were chosen (Figure 01).

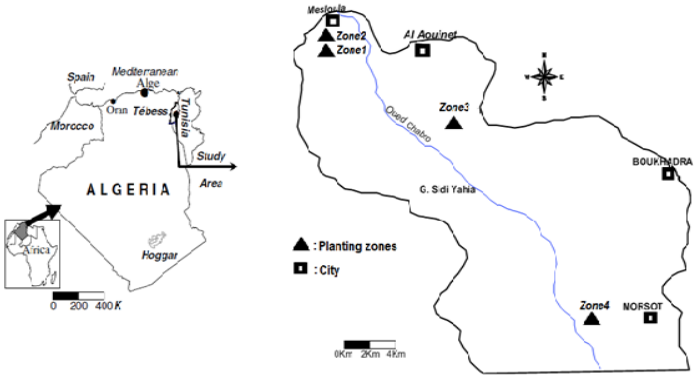

Figure 01*:* Map of plantation zones (black triangle) in the study area.

2-2- PLANTATION OF *ATRIPLEX*

Many authors have been interested in land development and rangeland development work such as (Benrebiha .1987).

One of the management techniques retained in the extensive program initiated by the state, is the forage plantation using exotic species *Medicago arborea, Opuntia ficusindica*, *Atriplex nummularia* and *Atriplex halimus.*

This additional work is part of the activities undertaken by the High Commissioner for Development of the Steppe (HCDS), for the fight against desertification since 1994, where the fodder planting component to restore degraded rangelands.

The present work aims at evaluating the impact of forage plantations based on *Atriplex nummularia* and *Atriplex halimus* on some physicochemical characteristics of soils.

The approach adopted is based on the synchronic study comparing planted soils of the two species of *Atriplex* and a control soil, in all four plots are defended for two years. The goal is to determine the effects of plantations on some physico-chemical parameters of the soil. The transplantation of plants obtained in nurseries in March 2020; prepares the ground by removing weeds, pebbles etc. The ground on 20-30 cm deep and in line with spacings of 5 × 2 m. Refresh the roots a few centimeters and remove the broken ones. Place three six-month-old seedlings in the same hole, each plot consisting of 24 holes for both species.

in any case, compact the soil very lightly to form a bowl and water copiously, the water will penetrate the earth around the roots and cause a natural settlement. Do not bury the shrub too deep, the collar should be at ground level.

3-SOIL SAMPLING

In order to carry out various soil analyzes, the sampling was random, fairly representative of the four planting zones, 24 soil samples were taken from the rhizosphere of *Atriplex halimus* and *nummularia* compared with the control soil. (soil planting sounds of a depth between 10-20 cm), due to two sampling outlets, the first in May 2020 and the second in September 2020.

All soil samples were collected and put in sealed bags identified; 1000g of soil of the horizon A on a depth of 18 to 25 cm.

In the laboratory of the Department of Biology, the collected soil samples were spread on paper and allowed to air dry under conditions where microorganisms do not have the possibility to modify their properties.

This step is followed by a separation of the fine and coarse parts of the soil with a round mesh screen of 2 mm diameter. The analyzes were carried only on the fine fraction (diameter <2 mm).

4- PARAMETERS STUDIED

To evaluate the impact of planting with both species of *Atriplex*. It is necessary to make the physico-chemical analyzes of soil.

Electrical conductivity is necessary for the study of the soil-absorbing complex. It is measured by the rate of passage of the electric current in the soil, the determination of the exchangeable and soluble bases (K +, Na +, Ca ++ and Mg ++) present in the soil in the form of salts (NaCl, CaCl 2, CaSO 4). Chloride Cl- assay by potentiometric titration with AgNO3-

The analysis of the soils studied was determined using leaching techniques for three days with a sol / water solution ratio of 1/5, that is 10 g of soil in 50 ml of water. distilled, the studied parameters are:

- Salinity parameter: CE (µS / cm), Salinity the apparatus used conductivity meter.
- The determination of the cations (Na +, K +, Mg +, Ca +) in (mg / l) and anions (Cl-, SO4-, NO_3-, HCO_3-) in (mg / l) was carried out by atomic absorption and photometer at flame.

5- STATISTICAL STUDY OF THE DATA

The statistical study was conducted on the basis of three factors studied:

- Two genotypes (*Atriplex halimus* and *Atriplex nummularia*) plus a control.
- Four plantation areas.

 Two sampling campaigns.

The averages of the variables measured on the different distributions were subjected to a variance analysis with three classification criteria, using the XLSTAT software.

6- RESULTS

Planting effect of *Atriplex halimus* and *nummularia*

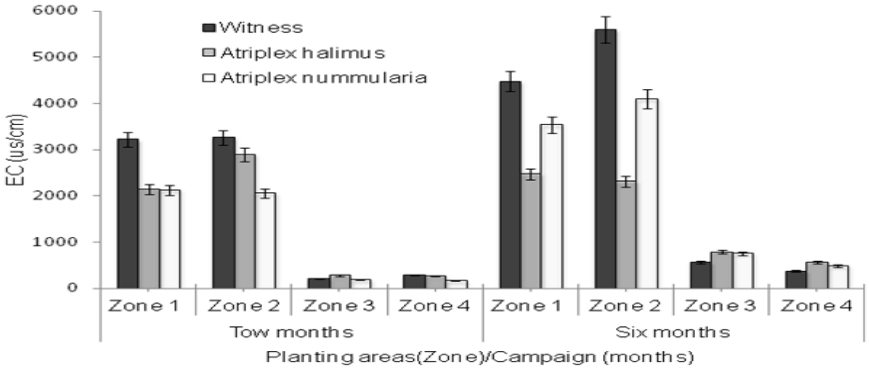

Fig. 2 Variation of the EC (µS / cm) values (means ± 95 % CI) of the soil solution in zones (zone 1, zone 2, zone 3, and zone 4) planted with Atriplex halumus (gray bars), Atriplex nummularia (white bars) and the control(black bars) after the campaigns (two months, and six months).

6-1- ELECTRICAL CONDUCTIVITY (C.E)

the variation of the values of the C.E according to the two variables: planting zones and the species planted at the level of the two companions. The results show, with some exceptions, that the EC decreases for the four areas at the two companions with the planting of both halophyte species, but in a non-proportional way, since the EC marked increases in the second companion for both species at the level of the third zone, and the fourth zone with respect to the witness. There was also an elevation of C.E. in the soil planted with *Atriplex halimus* at the third zone in the first companion compared to the control (soil without planting). (Figure 2).

Although this observation seems illogical, it can be argued that the plants studied are halophytes, they evolve greatly in saline soils

The variance analysis of the soil electrical conductivity indicates that the results are highly significant for the zone effect and significant for the companion effect and not significant for species effect and interactions.

The comparison test of the averages is done to confirm that the *Atriplex halimus* and the best halophyte species, with regard to the improvement of the electrical conductivity of the soil, for the two companions compared to the other species.

6-2- COMPARISON OF AVERAGES OF THE CATION (MG / L) CONTENT OF THE SOIL SOLUTION IN THE FOUR ZONES AFTER TWO AND SIX MONTHS OF *A.HALIMUS AND A.NUMMULARIA* PLANTING (Figure 3).

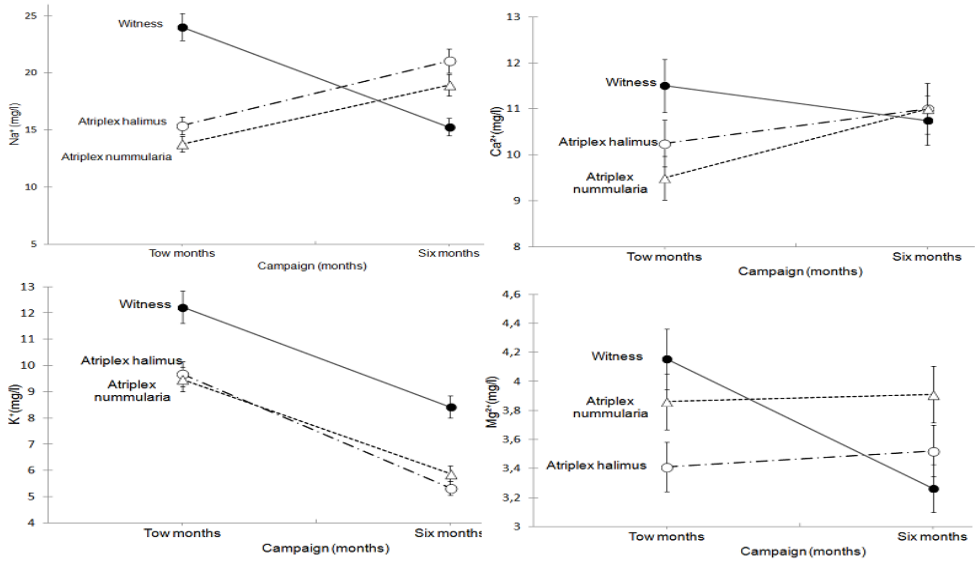

Fig. 3 Comparison (mean ± 95 % CI) of cations (Na^+, Ca^{2+}, K^+, Mg^{2+} (mg / l)) content of soil solution in the four zones after two and six months of planting between witness (filled circle), Atriplex halimus (open circle) and Atriplex nummularia (open triangle).

6-2-1--EFFECT ON Na + CONTENT: The results clearly show that the Na + content decreased in the first companion for the planted soils, except the result obtained by *Atriplex nummularia* in the fourth zone which shows an increase of 14.3 mg / l compared to the control 13.4 mg / ml. l. Nevertheless, this decrease was characterized by a low level with the four zones, the soil planted with the local species shows a good improvement (decrease) 7.8 mg / l and 11.9 mg / l, whereas at the level of the other species, the maximum values of Na + were below this 9.7 mg / l and 14.3 mg / l threshold compared with the control 10.4 mg / l and 13.4 mg / l in the second and fourth zones successively, while the first and the second third zone recorded for *Atriplex nummularia* 13.5 mg / l 17.6 mg / l marking a decrease compared to the *Atriplex halimus* 18.6 mg / l 23.3 mg / l and the control 48.7 mg / l 23.6 mg / l.
The Na + values recorded for the second companion have no ameliorative effect for the two species, except for the result of *Atriplex halims* which recorded a decrease of 15.6 mg / l compared to the control of 16 mg / l in zone one. , and the result of the *Atriplex nummularia* which recorded a decrease of 24.6 mg / l compared to the control 27.2 mg / l at zone three.
The variance analysis of the soil sodium content indicates that the results are significant for the zone effect and not significant for the companion species, species and interaction effect.The average comparison test reveals the effect of each plant on the two companions, from which we can say that the *Atriplex nummularia* has a greater effect compared to the *Atriplex halimus* only in the first companion.

6-2-2 EFFECT ON SOIL CONTENT IN Ca + 2
the variation in soil content, cultivated by the Atriplex species, in Ca + 2 in the four zones during both companions. Recorded Ca + 2 levels indicate that in general the soil substrate planted with the two studied species of Atriplex contains rates a little near and low relative to the soil without planting, where the soil substrate of A. nummularia contains the lowest proportion of Ca + 2 (8 mg / l and 9 mg / l) in zones one and four relative to the other species (10 mg / l and 11 mg / l) and the control (12 mg / l 10 mg / l) during the first companion, while that of Atriplex halimus which marks the lowest proportion in the zone two 9 mg / l compared with Atriplex nummularia 10 mg / l and the control 11 mg / l, the same result recorded for both species in the third zone 11 mg / l compared to the control 13 mg / l. In the second companion, however, the local species is characterized by a Ca + 2 content which takes the low position 11 mg / l compared to Atriplex nummularia and the control which have scored the same result 12 mg / l at the level of zone one, whereas the soil planted with Atriplex nummularia recorded low values in zone three 10 mg / l. compared to the Atriplex halimus 12 mg / l and the control 11 mg / l.
This is confirmed statistically, no significant effect for the species and campaign area and interactions.
The comparison test of averages showed that Atriplex nummularia is the favorable species for the improvement of the calcium content for the first companion, and for the second companion the control values and the two other species studied are almost the same.

6-2-3- EFFECT ON SOIL CONTENT IN K +
Shows the variation in soil content cultivated with K + *Atriplex* species in the study areas during both seasons. The K + contents contain different rates at the soil level planted with the two studied species of *Atriplex*, where the soil is planted with *A. nummularia* contains the lowest proportion of K + (6.3, 9.1 and 5.9 mg / l) in zones one, two and four during the first season, compared to the other species and the control, zone three planted with *Atriplex halimus* showed a decrease of 11.3 mg / l compared with *Atriplex nummularia* 16.6 mg / l and the control 16.4 mg / l.
During the second season, the soil planted with *Atriplex halimus* contains the lowest proportion in zones one and two (4 and 6.9 mg / l) compared with *Atriplex nummularia* 6.4 mg / l, 8.1 mg / l and the control 10 mg / l, 7.7 mg / l, however, the local species in zone four is characterized by a median K + content of 4.7 mg / l between *Atriplex nummularia* 1.3 mg / l and the control 12.9 mg / l
Variance analysis of soil potassium content indicates that the results are significant for companion effect and not significant for zone effect, species and interaction.
The average comparison test reveals that the planting of *Atriplex halimus* and *Atriplex nummularia* improves the K + content very closely between the two species
It should also be noted that the results clearly show that K + levels decrease a little more for planting with *Atriplex halimus*.

6-2-4- EFFECT ON SOIL CONTENT IN Mg + 2
shows us that the variation of the Mg + 2 levels did not correspond perfectly with the variation of the zones of plantations, this allows us to advance the implication of many other electrolytes in the determination of the EC .it is also to underline that the Mg + 2 content, soils two species studied, are not uniformly loaded, where the soil planted with the species A. halimus contains low values of Mg + 2 3.13 mg / l, 2.97 mg / l by compared to the other species 4.6 mg / l, 3.39 mg / l and the control 4.92 mg / l, 3.27 mg / l zones one and two during the first companion, only for the second companion these results suggest that the plantation used has no ameliorative effect on the Mg + 2 content except for the result of the soil planted with the local species in the second zone 0.68 mg / l given to the control 0.95 mg / l. This is confirmed statistically by a very significant difference for the variable area and not significant for the campaign effect, species and interactions.

6-3-COMPARISON OF AVERAGES OF THE ANION (MG / L) CONTENT OF THE SOIL SOLUTION IN THE FOUR ZONES AFTER TWO AND SIX MONTHS OF A.HALIMUS AND A.NUMMULARIA PLANTING.(figure 4)

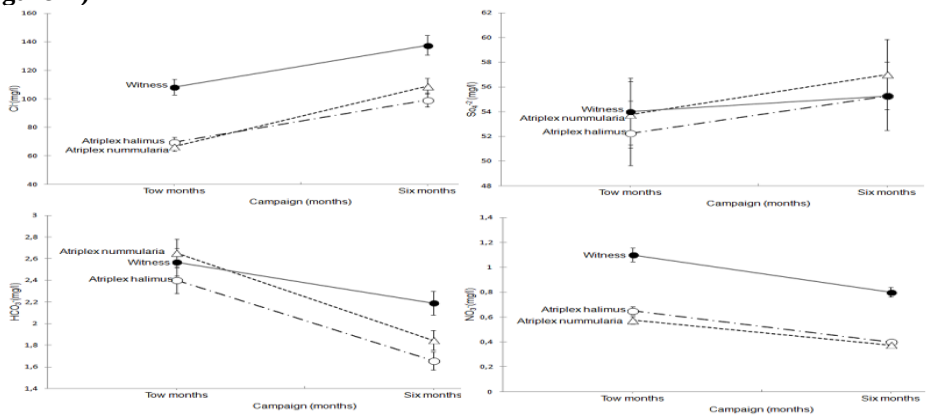

Fig. 4 Comparison (mean ± 95 % CI) of anions (Cl-, So42-, HCO3-, NO3- (mg / l)) content of soil solution in the four zones after two and six months of planting between witness (filled circle), Atriplex halimus (open circle) and Atriplex nummularia (open triangle).

6-3-1- EFFECT ON SOIL CONTENT IN Cl-

Recorded Cl-levels show that the two studied species of Atriplex contain rates a little near and low relative to the soil without planting, where A. nummularia contains the lowest proportion of Cl- (71 mg / l and 60.35 mg / l) in zones one and three compared to other species (106.5 mg / l and 63.9 mg / l) and the control (213 mg / l l 67.5 mg / l) in the first companion, whereas that of Atriplex halimus contains the lowest proportion in zones two and four (71 mg / l and 36.9 mg / l) compared with Atriplex nummularia (81.65 mg / l). mg / l and (53.25 mg / l) and the control (106.5 mg / l, 46.15 mg / l) During the second companion, in zones one and four, the local species is characterized by a Cl-median content. 106 mg / l, 85.10 mg / l between Atriplex nummularia 74 mg / l, 99.40 mg / l and control 213 mg / l, 71 mg / l, only for the soil planted by Atriplex halimus at zones two and three recorded low values 127.8 mg / l and 78.1 mg / l, compared to Atriplex nummularia (173.95 mg / l and 88.75 mg / l) and the control (177.5 mg / l and 88.75 mg / l).

Statistical analysis confirms these results by a very highly significant difference, in the campaign area species factors and highly significant for the effect of interactions.

6-3-2 EFFECT ON SOIL SO4-2 CONTENT

SO4-2 levels of soils planted with the two studied species of Atriplex contain different rates; in the first campaign the soil planted with the A. halimus contains the lowest proportion of SO4-2 (50 and 49 mg / l) compared to the other species (Atriplex nummularia) 53 mg / l and the control 55 mg / l and 50 mg / l at the two zones and three, the Australian species recorded the low value 52 mg / l compared to the control 55 and the other species 53 mg / l in the zone one, for the fourth zone, the two species mark an identical value 57 mg and lower than the control 58 mg / l; in the second companion Atriplex halimus has the lowest proportion in zone two 53 mg / l compared to Atriplex nummularia 55 mg / l and control 54 mg / l, however both species record the value of 58 mg / l lower than control 59 mg / l in zone four. The statistical analysis confirms these results by a very highly significant difference, for the country and area factors and significant for the species effect and countryside * area interaction and very significant for the zone interaction effect * species.

6-3-3- EFFECT ON SOIL CONTENT IN HCO3-

The results show that the HCO3- content decreases with the planting of the two halophyte species for the four zones at the level of the two companions, but in a non-proportional way with some exceptions,

We observed a decrease in the content of HCO3- in the soil planted with Atriplex halimus 1.54 mg / l and 3.3 mg / l in the first and the fourth zone during the first companion compared to the control (soil without planting) 1.94 mg / l and 4.13 mg / l and the soil planted with Atriplex nummularia 1.82 mg / l and 3.9 mg / l, the same remark for the second companion at the first, second and third zone the Atriplex halims which decreased HCO3- 1.66 mg / l, 1.8 mg / l and 1.08 mg / l compared to controls 3.1 mg / l, 2.3 mg / l and 1.1 mg / l and the other species 2.06 mg / l 2.28 mg / l and 1.1 mg / l.

The statistical analysis confirms these results by a very significant difference for the campaign effect and the zone effect and highly significant for the campaign * zone interaction and not significant for the species factor and the other interactions.

6-3-4- EFFECT ON SOIL CONTENT IN NO3-

The results shown in Figure.98 represent the change in NO3- soil content in the two Atriplex species according to the different areas in the two companions. The results clearly show that the NO3- content decreases in the two companions

for the planted soils except the result obtained by Atriplex nummularia in the second zone during the second companion 0.4 mg / l the same result for the control 0.4 mg / l.
In the first companion in zones one, three and four the NO3- content marked lower values in soils planted with Atriplex nummularia 0.4 mg / l, 0.4 mg / l and 0.0 mg / l compared to the other species 0.6 mg / l, 0.5 mg / l and 0.1 mg / l and control 1.1 mg / l, 0.7 mg / l and 0.2 mg / l, at zone two, the soil planted with Atriplex halimus has registered the minimum value of 1.4 mg / l compared to the other species 1.5 mg / l and the control 2.4 mg / l, during the second campaign the decrease of the NO3- content is changing in soils planted with the species of Atriplex, of which the Atriplex halimus scored values lower than zones two, three, and four 0.1 mg / l, 0.3 mg / l and 0.2 mg / l compared to the other species 0.4 mg / l, 0.4 mg / l and 0.3 mg / l and the control 0.4 mg / l, 0.9 mg / l and 0.6 mg / l. The statistical analysis confirms these results by a significant difference for the campaign effect and the species effect, and very significant for the zone effect and the campaign * zone interaction and not significant for the other interactions.

7-DISCUSSIONS

7-1 ELECTRICAL CONDUCTIVITY (C.E)

Thus the C.E of soils planted with Atriplex halimus and Atriplex nummularia, is lower than that of controls. According to several authors Atriplex plants are stimulated by the moderate doses of NaCl and as they develop, they load with the absorbed salts and simultaneously unload the soil on which they grow (Edwar and al . 1998).

7-2-EFFECT ON Na + CONTENT

These results go together with those of (Miyamoto and al.1996) who measured at the end of an experiment similar to ours, the level of salinity of soil drainage water. They found that salinity remained proportional with the first intake of salt.
Indeed, the majority of the plants receiving the highest concentrations of salt showed a great delay of development, or even, they were lost.
These results also reveal that the increase in Na + content in the two plants studied was not proportional to the increasing salt content of soils.
- Effect on soil content in Ca + 2
The comparison test of averages showed that Atriplex nummularia is the favorable species for the improvement of the calcium content for the first companion, and for the second companion the control values and the two other species studied are almost the same

7-3- EFFECT ON SOIL CONTENT IN K +

According to (Cengiz and al. 2001), under salt stress, the potassium of the external environment is strongly mobilized towards the plant. This may explain the reduction of soil K + levels under high salt levels.
- Effect on soil content in Mg + 2
The average comparison test showed that the species Atriplex halimus is better for improving the magnesium content of the soil only for the first companion
It is thought that this Mg + 2 soil content, which is higher in the control and the introduced species, is not due to a weak assimilation of this element in the soil, because the plants on which are developed are more heavily loaded. mg + 2. and / or the recirculation of excess salts to the roots via the elaborated sap and their elimination to the soil (Berthomieu and al .2003). The results show that the highest values for this element were recorded in soils without planting and the soil planted with Atriplex nummularia.

7-4- EFFECT ON SOIL CONTENT IN Cl-

The comparison test of averages showed that Atriplex nummularia is the species that improves the chloride content during the first companion compared to the Atriplex halimus, but it is the opposite for the second companion.
mularia (173.95 mg / l and 88.75 mg / l) and the control (177.5 mg / l and 8
- Effect on soil SO4-2
The comparison of averages reveals the effect of each plant on the two companions, however the Atriplex halimus is better compared to the Atriplex nummularia only for the first companion, although the results of the two species are very close.
- Effect on soil content in HCO3-
The comparison test of averages showed that Atriplex halimus is the favorable species for improving the bicarbonate content for both companions .
- Effect on soil content in NO3-
The comparison test of averages showed that Atriplex nummularia is the favorable species for the reduction of the nitrate content for both companions

8 - CONCLUSION

From the above, concerning the variation of the soil parameters as a function of the salinity, the effect of the plants studied, it can be concluded that the increase in salinity affects all the measured physicochemical components of the soil, but with an intensity, more or less, variabl In contrast to the EC , which showed a positive correlation with the

effect of the species, particularly with regard to the Atriplex halimus. With regard to soil minerals (cations and anions), it should be remembered that the calcium and potassium sodium levels showed a tendency to decrease with respect to the two halophytic species, especially the species A.nummularia; noting that the lowest level of Mg + 2 corresponded to the local species A. halimus and to the different saline soils only in the first companion. This could imply a blockage of sodium (Na +) under the effect of Mg + 2 soil, Thus, the plant could benefit from the latter action to mitigate the transfer of Na + soil to the plant. As for cations, soil anions such as Cl-, SO42-, HCO3- recorded the lowest levels in soil planted with A. halimus, on the other hand, NO3- recorded the lowest levels at the soil level planted with Atriplex nummularia.

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