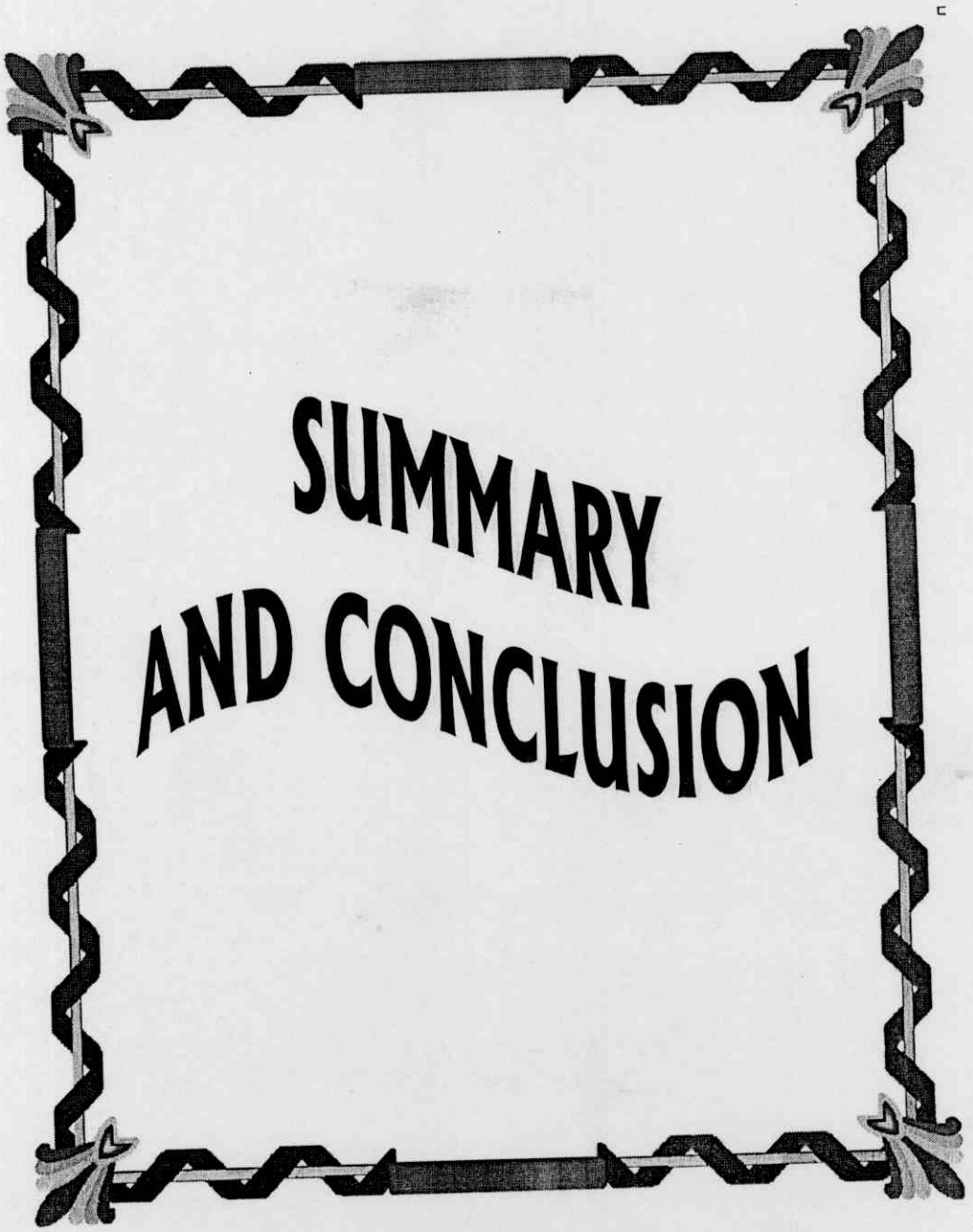
SUMMARY
AND CONCLUSION

V- SUMMARY AND CONCLUSION

The present study was carried out on one year old potted transplants of coronaiki, Manzanillo and Aghizi olive cultivars in Horticultural Research Institute nursery; Giza Governorate during two successive seasons of 2000 and 2001. It was aimed to investigate salt tolerance of three olive cultivars grown in sandy soil and possibility of minimizing the depressive effect of salt stress. Thus two experiments were conducted using the complete randomized block design with three replications, whereas each was represented by 3 transplants (grown individually in 30.0 cm diameter plastic pots filled with specific weight of sandy soil (6.0 kg) brought from eastern desert along Cairo, Esmailia Road) 65 km from Cairo.

V-I- Experiment 1:

Effect of salinity concentration, sodium adsorption (S.A.R.) and chloride level ($Cl:SO_4$ ratio) on transplants of 3 olive cvs. grown on sandy soil.

Investigated treatments were representative of different thirty nine (39) combinations between three olive cvs. (coronaiki, Manzanillo and Aghizi), and 3 levels of saline concentrations (2000, 4000 and 6000 ppm); two sodium absorption ratios (3 & 6) and two $Cl:SO_4$ ratios (low & high) beside irrigation with tap water as control.

V-II- Experiment 2:

Effect of some nutrient elements (P, K & Zn) foliar spray on olive transplants grown under saline solution (irrigated with 6000 ppm salt concentration of S.A.R.-6 and two levels of $Cl:SO_4$ ratio, (low & high):

Salt tolerance of olive transplants was studied through investigating the influence of (18) treatments representative of various combinations between 3 olive cultivars (coronaiki, Manzanillo and Aghizi), grown under salt stress 6000 ppm of S.A.R.-6 and two levels of $Cl:SO_4$ ratios (low & high) and foliar spray with 3 nutrient elements solutions (500 ppm phosphorus as H3 PO_4, 500 ppm potassuim and 100 ppm Zn EDTA), monthly adopted from 1st June up 1st October of both seasons.

Transplants in the two experiments were supplied with saline solution every three days at the rate of ¾ liter / pot. To prevent salts accumulation all pots were irrigated with tap water every 12 days followed by re-watering with the corresponding salt solution the next day.

Specific and interaction effects of the investigated factors and their combinations included in the aforesaid 1^{st} & 2^{nd} factorial experiments were studied through the response of the following measurements:

1- Growth parameters:

Average length of (stem, root and total plant); number of (shoots /laterals & leaves/plant); (average leaf area)& total assimilation area); fresh and dry weights of various transplant

organs (leaves, stem, roots and total plant) were the investigated growth measurements in 1st and 2nd experiments.

2- Some physiological properties:

In this regard, leaf relative turgidity (L.R.T); leaf water potential (L.W.P.); leaf succulence grade (L.S.G.); hard leaf character (H.L.C.); leaf transpiration rate (L.T.R.) and leaf osmotic pressure (L.O.P. in bar) were investigated (in 1st & 2nd experiments).

3- Chemical analysis:

Photosynthetic pigments (foliar pigments); total carbohydrates and soluble sugars; total free amino acids and proline contents; some enzymes activity (catalase & peroxides) and nutritional status (leaf, N, P, K, Ca, Mg, Na, Fe, Mn and Zn contents) in response to the included treatments of 1^{st} and 2^{nd} experiments were investigated.

4- Anatomical structure:

Leaf and root anatomical structures of 3 olive cultivars "Aghizi shami, Manzanillo and Coronaiki", as influenced by salt stress(6000 ppm with 3&6 S.A.R. and two Cl:SO_4 ratios (1^{sh} experiment) and foliar sprays of saline stressed transplants with P; K and Zn (at 500 for both former elements and 100ppm for later one) were studied.

Thickness of: (upper & lower cuticle and epidermis layers); mesophyll (palisade & spongy tissue); No. of xylem arms and xylem vessel of leaves besides; periderm thickness; No of xylem arms and vessels; thickness of phloem, xylem vessels

and diameter of vascular cylinder were the root anatomical characteristics investigated through microscopic examination of leaf and root cross section.

Data obtained during both experimental seasons 2000 & 2001 could be summarized as follows:

V.I Experiment 1:

Effect of different salt concentrations, SAR ratio and chloride levels (Cl: SO_4 ratio on transplants of 3 olive cultivars grown on sandy soil :

V.I.1- Growth measurements:

In this regard 15 growth parameters namely: length of (stem, root and total plant); number of (laterals & leaves/plant); (leaf & total assimilation area); fresh and dry weights of various transplant organs (leaves, stem, root and total plant) in response to specific effect of four studied factors (olive cultivar, salt concentration; S.A.R. ratio and chloride levels (Cl:SO_4 ratio) as well as interaction effect of their possible combinations were investigated during both 2000 and 2001 seasons.

A- Specific effect:

1- Regarding the specific effect of olive cultivar, data obtained during both seasons revealed that Coronaiki cvs. was the superior with all the investigated growth measurements while Aghizi cvs. was the inferior with length of (stem, root and total plant) and number of (laterals & leaves/plant) as well as Manzanillo cvs. for average area of individual (leaf & assimilation area/plant) and fresh & dry weights of

various organs (leaves, stem, root and total plant) during the two seasons of study.

2- As for the specific effect of salt concentration; data obtained displayed obviously that increasing salt concentration or increasing ratios of either S.A.R. (from 3 to 6)or ($Cl:SO_4$) in irrigation water significantly decreased all the investigated growth measurements under study i.e., length of (stem, root and total plant); Number of (laterals & leaves/plant); average area of individual (leaf & assimilation area/plant) and fresh and dry weights of various organs (leaves, stem, roots and total plant).

B- Interaction effect:

Data obtained revealed that specific effect of each investigated factor was directly reflected on its own combinations. Herein, the Coronaiki transplants irrigated with 2000 ppm salt concentration x S.A.R.-3 and low chloride level ($Cl:SO_4$ ratio) exhibited statistically the greatest values of various growth parameters during the two seasons of study. On the contrary, the least values of the investigated growth measurements were always in concomitant to those olive transplants subjected to the 6000 ppm salt concentration x S.A.R.-6 x high chloride level ($Cl:SO_4$ ratio), regardless of cultivar. However, there was a gradual tendency pointed out that the rate of reduction in growth measurements of Coronaiki transplants was less pronounced as compared to those exhibited in two other cultivars.

V.I.II. Some leaf physiological properties:

Leaf relative turgidity (L.R.T.); leaf water potential (L.W.P.); leaf succulence grade (L.S.G.); hard leaf character (H.L.C.); transpiration rate (T.R.) and osmotic pressure (L.O.P.) in response to olive cultivar; salt concentration, SAR ratio; chloride level ($Cl:SO_4$ ratio) in irrigation water and their combination were the investigated leaf physiological properties.

The obtained results could be summarized as follows:

A- Specific effect:

Data obtained during both seasons, displayed that the aforesaid 6 physiological leaf properties didn't follow the same trend regarding their response to specific effect of a given factor of the 4 investigated ones (olive cultivar, salt concentration, S.A.R. ratio and chloride level. Hence, each factor followed its own trend. Anyhow, it could be concluded that:

1- Regarding the specific effect of olive cultivar, data obtained revealed that the highest values of leaf relative turgidity (L.R.T.); leaf water potential (L.W.P.), leaf succulence grade (L.S.G.) and leaf osmotic pressure were always in concomitant to coronaiki transplants, while the reverse was true with Aghizi cvs. Differences were significant with the four physiological leaf characteristics.

On the other hand, Aghizi transplants exhibited significantly he highest values of both hard leaf character (H.L.C.) and transpiration rate while the opposite was found with Coronaiki cvs.

In addition, Manzanillo cvs. was intermediate as compared to two other olive cultivars under study regarding the response of all physiological leaf properties.

2- Concerning the specific effect of salt concentration; obtained results revealed that the highest values of (L.R.T.), (L.W.P.), (L.S.G.) and (T.R.) were significantly coupled to the continuously tap water irrigated transplants while the reverse was found with the highest salt concentration in irrigation water. However, both (H.L.C.) and (L.O.P.) the trend took the other way around during the two season of study.

3- Results Cleared a significant increase in (L.W.P.); (L.S.G.); (H.L.C.) and (L.O.P.) with increasing either S.A.R. (from 3 to 6) or chloride level ($Cl:SO_4$ ratio) while the opposite was found for both (L.R.T.) and (T.R.) during the two seasons of study.

B- Interaction effect:

1- Data obtained regarding the interaction effect of (olive cvs. x salt concentration x S.A.R. x chloride level) showed that the highest values of (L.R.T.) and (L.W.P.) exhibited statistically their highest values by coronaiki transplants irrigated with tap water fallowed by transplants of the same cvs. subjected to saline solution of 2000 ppm salt concentration and lower ratio of S.A.R. at and chloride level. On the other hand, the reverse was true when Aghizi transplants irrigated with the highest salt concentration (6000 ppm) x S.A.R.-6 and highest chloride level. Moreover, other combinations were in between regarding such 2 physiological properties.

2- The interaction effect between the four investigated factors i.e., olive cultivars; salinity concentration; S.A.R. ratio and chloride level (Cl: SO_4 ratio) in the irrigation water on leaf succulence grade (L.S.G.) showed that the combination between coronaiki cvs. x 2000 ppm x S.A.R.-6 x high chloride level exhibited the highest value while Aghizi cvs. x 6000 ppm x S.A.R.-6 x low or high chloride level decreased significantly such leaf physiological character during the two seasons of study. Moreover, other combinations were in between.

3- Obtained results revealed that the highest value of hard leaf character associated with Aghizi transplants irrigated with the highest salt concentration (6000 ppm) x S.A.R.-6 x high level of chloride. The reverse (least value of H.L.C.) was found with irrigated coronaiki transplants with 2000 ppm salt concentration x S.A.R.-3 with low chloride level during the two seasons of study.

4- The highest values of osmotic presser and lowest values of leaves transpiration rate was exhibited by Coronaiki cvs. which irrigated with 6000 ppm x S.A.R.-6 x high chloride level. The reverse was true with irrigated Aghizi transplants with 2000 ppm x S.A.R.-3 x low chloride level. Herein, osmotic pressure and transpiration rate exhibited their highest value of transpiration rate and lowest value of leaf osmotic pressure. Moreover, other combinations were in between regarding such 2 leaf physiological properties during the two seasons of study.

V.I.III. Chemical composition:

V.I.III-1 Photosynthetic pigments (foliar pigments):

Data obtained regarding leaf photosynthetic pigments contents (chlorophyll A; B and carotenoids compounds) of olive transplants as influenced by the specific and interaction effects of olive cultivars, salt concentration, S.A.R. and chloride $Cl:SO_4$ ratios in irrigation water and their possible combination revealed that:

A- Specific effect:

1- Concerning the specific effect of olive cultivars on leaf chlorophyll (A & B) and carotenoids compounds were generally the richest in Coronaiki transplants followed in a descending order by those of Aghizi and Manzanillo cvs. during the study.

2- The obtained results revealed that, chlorophyll (A & B) and carotenoids compounds in olive leaves, were progressively decreased by saline solutions where both significantly decreased with increasing either salts concentration, sodium adsorption ration (S.A.R.) or chloride level ($Cl:SO_4$ ratio) in the irrigation water during the two seasons of study.

B- Interaction effect:

It could be generally concluded that Coronaiki transplants irrigated with 2000 ppm salt concentration x S.A.R.-3 with low chloride level ($Cl:SO_4$ ratio) had the richest leaves with both chlorophyll (A & B) and carotins. The reverse was true with Manzanillo cvs. irrigated with salt

concentration at 6000 ppm x S.A.R.-6 of higher level of chloride. Moreover, other combinations were in between during the two seasons of study.

V.I.III.2- Total carbohydrates and soluble sugars:

A- Specific effect:

Data obtained during both seasons revealed that total carbohydrates and soluble sugars contents of transplants shoots respond specifically to the four investigated factors i.e., olive cvs. salt concentration, S.A.R. and chloride level in irrigation water. Hence, Coronaiki cvs. was statistically the richest in both total carbohydrates and total soluble sugars. However, both components followed two conflicted trends in response to either salt concentration or sodium adsorption ratio as well as chloride level (Cl: SO_4 ratio).

In this concern, total carbohydrates of shoots tended to decrease with increasing salt concentration or sodium adsorption ratio (S.A.R.) and chloride level while the trend took the other way around with total soluble sugars during the two seasons of study.

B- Interaction effect:

Obtained resulted revealed that total carbohydrates and soluble sugars each followed its own trend regarding the response to interaction effect of the 4 investigated factors. Herein, the highest value of total carbohydrates associated with the lowest one of total soluble sugars. Were exhibited by such combination between Coronaiki cvs. x 2000 ppm x S.A.R.- 3 x low chloride level. On the other hand, Aghizi cvs. irrigated with

6000 ppm salt concentration with S.A.R.-6 and high chloride level showed the highest value of total soluble sugars and lowest value of total carbohydrate during the two seasons of study. Moreover, other combinations were in between.

V.I. III.3. Leaf salinity hazard coefficient (L.S.H.C.);

A specific effect:

1- As for the specific effect of olive cultivar, it is quite evident that, the highest values of leaf salinity hazard coefficient (L.S.H.C.) was always in closed relationship to Coronaiki cvs., while the reverse was true with Aghizi cvs. In addition, Manzanillo cvs. was intermediate during the two seasons of study.

2- Results also cleared a significant increase in leaf salinity hazard coefficient with increasing either salt concentration or sodium adsorption ratio from 3 to 6 and chloride level ($Cl:SO_4$ ratio) in irrigation water during the study.

B- Interaction effect:

The interaction effect between the four investigated factors i.e. olive cultivars, salinity concentration, sodium adsorption ratio (SAR) and chloride level ($Cl:SO_4$ ratio) in the irrigation water on leaf salinity hazard coefficient in olive seedlings, showed that combination between the highest salinity concentration (6000 ppm) x S.A.R.-6 x higher $Cl:SO_4$ ratio in Manzanillo cvs increased significantly the (L.S.H.C.) However, the lowest value of (L.S.H.C.) was detected by Aghizi

transplants irrigated with 2000 ppm salt concentration x S.A.R.-3 x low $Cl:SO_4$ ratio during the two seasons of study.

V.I.III.4. Total free amino acids and proline contents:

1- Data obtained displayed that total free amino acids and proline contents responded specifically to each investigated factor and followed the same trend. Aghizi cultivar was the superior while coronaiki the inferior and Manzanillo was intermediate.

2- The obtained results revealed that, total free amino acids and proline contents progressively increased by raising.

3- Results also declared a significant increase in both total free amino acids and proline contents with increasing either sodium adsorption ratio (S.A.R.) or chloride level ($Cl:SO_4$ ratio) during the two seasons of study.

B- Interaction effect:

The highest levels of both total free amino acids and proline contents were in closed relationship to Aghizi transplants irrigated with 6000 ppm x S.A.R.- 6 x higher $Cl:SO_4$ ratio. The reverse was true with Coronaiki transplants irrigated with 2000 ppm saline solution of S.A.R.- 3 and lower $Cl:SO_4$ ratio as compared with other combinations of saline solutions, however all salinity stress of transplants exceeded the analogous ones of tap water irrigated ones (control) during the two seasons of study.

V-I-III-5- Catalase and peroxidase enzyme activities:

Manzanillo cultivar showed the greatast level of both catalase and peroxidase activities during the two seasons of study.

However, both catalase and peroxides followed two conflicted trends regarding their response to salt stress i.e., salt concentration, sodium absorption ratio (S.A.R.) and chloride level ($Cl:SO_4$ ratio). Herein, with peroxides its activity was obviously increased in olive transplants with increasing salt concentration and decreased with increasing either sodium adsorption ratio or chloride level ($Cl:SO_4$ ratio). On the other hand the trend took other way around for catalase activity.

V.I.III.6. Leaf mineral composition:

Data obtained regarding the leaf N; P; K; Ca; Mg; Na; Fe; Mn and Zn contents of olive transplants in response to specific and interaction effects of olive cultivar; salt concentration sodium adsorption ratio (S.A.R.) ; chloride level ($Cl:SO_4$ ratio) in irrigation water and their possible combinations revealed the following:

A- Specific effect:

1- Concerning the specific effect of olive cultivar, data obtained during both seasons revealed that Coronaiki cultivar exceeded statistically the two other cultivars, (Manzanillo and Aghizi) regarding their leaf N; P; K; Mg., Fe; Mn; and Zn contents. However, with both leaf (Ca& Na)contents the trend took the other way around during two seasons.

2- Results showed that increasing any of either (salt concentrations; S.A.R. or chloride level decreased significantly leaf N; P; K; Mg ; Fe ; Mn and Zn contents but significantly increased leaf Ca and Na contents as compared to control treatment during the two seasons of study.

B- Interaction effect:

A significant variations in leaf mineral due to interaction between olive cultivar; salt concentration; sodium adsorption ratio (S.A.R.) and chloride level ($Cl:SO_4$ ratio) were detected. Meanwhile, Coronaiki cultivar x 2000 ppm salt concentration of S.A.R.- 3 and lower chloride level($Cl:SO_4$ ratio) showed the highest value of leaf N; P; K; Mg; Fe; Mn and Zn contents and lowest value of leaf - Ca and Na contents. On the other hand; Aghizi cv. x6000 ppm x S.A.R.-6 x higher chloride level had the lowest values of leaf - N; P; k; Mg; Fe; Mn and Zn contents and higher values of leaf - Ca and Na contents during the two seasons of study.

V.II. Experiment II: Effect of some nutrient foliar sprays on olive transplants grown under salt stress (irrigated with 6000 ppm salinity with S.A.R.-6 and two chloride levels in irrigation water):

In this regard specific and interaction effects of three investigated

factors i.e., olive cultivars (coronaiki, Manzanillo and Aghizi); kind of nutrient foliar spray (P & k at 500 ppm and Zn at 100 ppm); two chloride levels (low & high) and their possible combinations were studied regarding the influence on some

growth measurements, leaf physiological characteristics and chemical composition.

The obtained results could be summarized as follows:

V.II.I. Growth measurements:

Length (stem, root and total plant); number of (laterals & levels/plant); average leaf area and total assimilation area/plant; fresh and dry weights of different transplant organs (leaves, shoots, roots and total plant) were the investigated growth measurements.

A- Specific effect:

1- Concerning the specific effect of olive cultivar, data obtained during both seasons displayed that Coronaiki cultivar exceeded two other ones in all growth measurements, while Aghizi was the inferior in this concern.

2- As for the specific effect of nutrient foliar spray, data obtained during both seasons displayed that the three nutrients foliar sprayed (p, k & Zn) increased significantly all growth measurements as compared to control plants (unsprayed salt stressed).However was more effective for length measurements of stem; root and total plant

3- Zinc foliar followed in a descending order by k and p foliar sprays in this concern.

4- Phosphorus foliar spray ranked 1st as number of leaves, laterals/plant, leaf area, assimilations leaf area and fresh and dry weights of transplant organs (shoots, roots and total plant)

followed in a descending order by K followed by Zn foliar sprays in this concern.

5- Increasing chloride levels ($Cl:SO_4$ ratio) in irrigation water resulted in reducing all growth measurements length (shoots, roots & total plant), No of leaves & laterals/plant, leaf & total assimilation area/plant) and fresh & dry weights (leaves, stem, roots & total plant) in this concern.

B- Interaction effect:

1- A significant interaction effect was detected as a result of the interaction between olive cultivar, sprayed nutrient element and chloride level, where Coronaiki transplant sprayed with Zn at 100 ppm and irrigated with salt solution of 6000 ppm concentration S.A.R.-6 and low chloride level showed the highest increase in (stem, root and total plant length) as compared to the plant under salt stress during two seasons of study.

2- A mark able increase was found by p foliar spray of salinity stressed Coronaiki transplants at lower $Cl:SO_4$ ratio where the greatest values of number of (leaves & laterals /plant);(leaf & total assimilation area/plant) and fresh &dry weights of plant organs (leaves , stem, roots and total plant) were detected during both seasons either compared to control (unsprayed transplants) or other sprayed ones.

3- The least values of all investigated growth measurements were always in closed relationship to such saline stressed transplants especially of Aghizi cvs. at higher $Cl:SO_4$ ratio without spray treatments.

V.II.II. Leaf physiological properties:

Six physiological characteristics (leaf relative turgidity; leaf water potential; hard leaf character; leaf succulence grade; transpiration rate and osmotic pressure) were investigated regarding the specific and interaction effects of olive cultivar; kind of nutrient foliar spray; chloride level (Cl: SO_4 ratio) in irrigation water and their combinations.

A- Specific effect:

1- Data obtained revealed that all investigated leaf physiological characteristics didn't follow the same trend in their response to specific effect of either olive cultivar, sprayed nutrient element or chloride level (Cl: SO_4 ratio).

2- As for the specific effect of olive cultivar, it is quite evident that the highest values of leaf relative turgidity (L.R.T.); leaf water potential (L.W.P.); leaf succulence grade (L.S.G.) and somatic pressure (L.O.P.) were always in Closed relationship to the coronaiki cvs. while the reverse was true with Aghizi cvs. during the study. In addition, Aghizi cvs. showed statistically the highest values of both hard leaf character (H.L.C.) and transpiration rate (T.R), while Manzanillo cvs. was in between the two extremes representing the aforesaid two olive cultivars during the both seasons of study.

3- Concerning the specific effect of nutrient element spray, data obtained pointed out that both (P & K) at 500 ppm and Zn at 100 ppm increased leaf (L.R.T.);(L.S.G),water potential(L.W.P.)and osmotic pressure (L.O.P.) but decreased

transpiration rate(T.R.) and (H.L.C.)as compared with the control (unsprayed ones) during the two seasons of study.

4- The obtained results revealed that, leaf relative turgidity (L.R.T.) and leaf succulence grade (L.S.G.) K spray was more effective for increasing both while Zn foliar spray was more effective for reducing both hard leaf character((H.L.C.)and osmotic pressure (L.O.P.) during two seasons of study. On the ether hand with leaf water potential (L.W.P.)and transpiration rate (T.R.) three nutrient elements were statistically of the some efficiency.

5- Increasing chloride level ($Cl:SO_4$ ratio) in irrigation water caused decreased significantly the leaf relative turgidity (L.R.T.)and increased significantly the hard leaf character (H.L.C.); leaf succulence grade (L.S.G.) and osmotic pressure (L.O.P.) from one hand but didn't influence water potential (L.W.P.) and transpiration rate((T.R.)from the other during two seasons of study.

B- Interaction effect:

1- Data obtained revealed that the investigated leaf physiological properties didn't follow the same trend in their response to the interaction effect of olive cvs. x sprayed nutrient elements x chloride level combinations. Herein; in most cases each character followed its own trend.

Anyhow, it could be generally concluded that the highest values of leaf succulence grade (L.S.G.)and osmotic pressure (L.O.P.) were in Closed relationship to K sprayed Coronaiki transplants irrigated with 6000 ppm saline solution of S.A.R.-6

and higher chloride level while the lowest values was markedly coupled with unsprayed salt stressed transplants of Aghizi cvs. x low chloride level.

2- On the other hand, the highest values of (L.R.T) was markedly coupled with salinity stressed transplants of Coronaiki cvs.at lower $Cl:SO_4$ ratio and sprayed with k solution. However, zinc spray of salinity stressed Coronaiki transplants (6000 ppm; S.A.R.-6 and lower $Cl:SO_4$ ratio)exhibited statistically the greatest leaf water potential value. Meanwhile, the salt stressed transplants of Aghizi cvs. sprayed with Zn or unsprayed with high chloride level showed the least values of (L.R.T) and (L.W.P); respectively. In addition, unsprayed salt stressed Aghizi transplants (regardless of $Cl:SO_4$ ratio) showed the highest value of (H.L.C). While Coronaiki transplants salt stressed of lower chloride level and sprayed with p foliar spray cause the lowest value of hard leaf character during the study.

V.II.III. Chemical composition:

V.II.III.I. Photosynthetic pigments (foliar pigments):

Leaf chlorophyll (A&B) and carotenes contents of salt stressed olive transplants in response to specific and interaction effects of olive cultivar; sprayed nutrient elements; chloride level ($Cl:SO_4$ ratio) in irrigation water and their possible combinations were investigated.

A- Specific effect:

Data obtained during both seasons displayed that the three photosynthetic pigments (foliar pigments) followed the same trend regarding the specific effect of either olive cultivar or sprayed nutrient element and chloride level ($Cl:SO_4$ ratio) in irrigation water. Hence Coronaiki leaves were statistically the richest while Aghizi leaves were the poorest in their 3 pigments contents. Meanwhile, all the 3 sprayed nutrient increased the 3 foliar photosynthetic pigments, while potassium foliar spray was more effective followed in a descending order by phosphorus in this concern. In addition, increasing chloride level ($Cl:SO_4$ ratio) in irrigation water decreased significantly 3 photosynthetic pigments during two seasons of study.

B-Interaction effect:

Data obtained during both seasons revealed obviously that specific effect of each investigated factor i.e., olive cultivar; sprayed nutrient element and chloride level ($Cl:SO_4$ ratio) in irrigation water was directly reflected on its own combinations. Herein, the Coronaiki transplants under salt stress of low chloride level and sprayed with potassium at 500 ppm exhibited statistically the greatest values of chlorophyll (A & B) and carotenaids compounds.

The reverse was true with unsprayed Manzanillo salt stressed transplants with higher $Cl:SO_4$ ratio. However, other combinations were in between the aforesaid 2 extremes.

V.II.III.2. Stem total carbohydrates and soluble sugars:

A- Specific effect:

Both total carbohydrates and soluble sugars of olive shoots followed two conflicted trends regarding their response to either olive cultivar or sprayed nutrient element and chloride level ($Cl:SO_4$ ratio).

Herein, with regard to specific effect of olive cultivar, data obtained revealed that, coronaiki transplants was statistically the richest stem total carbohydrates content, and the poorest stem total soluble sugars, while the reverse was found with Aghizi transplants. Meanwhile Manzanillo cultivar was intermediate in this concern.

As for the specific effect of sprayed nutrients (P, K & Zn), it is quite clear that both chemical constituents followed two conflicted trends, where total carbohydrates were decreased but total sugars were increased. Phosphorus was more effective than two other nutrients (K % Zn) for two other increasing total carbohydrates with Zn was the most depressive than nutrients (P & K) as the decrease in total soluble sugars.

With regard to the specific effect of chloride level, data obtained revealed that both chemical constituents followed two conflicted trends, where total carbohydrates were decreased but total soluble sugars were increased with increasing chloride level ($Cl:SO_4$ ratio) in irrigation water during the two seasons of study.

B- Interaction effect:

Data obtained during both seasons revealed that shoots total carbohydrates and total soluble sugars each followed its own trend regarding their response to interaction effect of combinations between three studied factors i.e., olive cultivar; sprayed nutrients elements and chloride level ($Cl:SO_4$ ratio) in irrigation water. Herein, the highest level of total carbohydrates was always in concomitant to 500 ppm p or k sprayed transplants of Coronaiki while unsprayed Aghizi transplants which irrigated with 6000 ppm saline solution of higher chloride level had the lowest value. On the other hand, the unsprayed Aghizi transplants irrigated with 6000 ppm saline solution of high level of chloride exhibited the highest value of total soluble sugars while sprayed Coronaiki transplants with Zn which irrigated with saline solution have the lower level of chloride ($Cl:SO_4$ ratio) showed the least levels of total soluble sugars during two seasons of study.

V.II.III.3. Leaf salinity Hazard coefficient (L.S.H.C.):

1- As for the specific effect of olive cultivar, data obtained during both seasons displayed that Aghizi cultivar exceeded two other cultivars in leaf salinity hazard coefficient value while Coronaiki was the inferior. In this concern.

2- Concerning the specific effect of nutrient sprayed elements data obtained revealed that, p ; k or Zn foliar spray decreased L.S.H.C. and Zn foliar spray was more effective in this respect.

Regarding the specific effect of chloride level ($Cl:SO_4$ ratio), data obtained during both seasons displayed that leaf salinity hazard coefficient value increased with increasing chloride level in irrigation water during two seasons of study.

B- Interaction effect:

Data obtained revealed obviously a considerable response in leaf salinity hazard coefficient investigated regarding the influence of interaction effect of various combinations between 3 studied factors (olive cvs.; sprayed nutrient elements and chloride level in irrigation water) where, such response represented the direct reflection of specific effect of each investigated factor. Anyhow, it could be generally concluded that leaf salinity hazard coefficient exhibited their greatest value by Aghizi transplants (unsprayed) under salt stress with low chloride level ($Cl:SO_4$ ratio). On the other hand, Manzanillo transplants treated with Zn at 100 ppm had the least value of leaf salinity hazard during two seasons of study.

V.II.III.4. Leaf total amino acids and proline contents:

A- Specific effect:

Concerning the specific effect of olive cultivar; sprayed nutrient element and $Cl:SO_4$ ratio data obtained revealed that both total free amino acids and praline contents followed the same trend. Herein, Aghizi transplants had statistically the richest leaves, while the reverse was found with Coronaiki cvs. Meanwhile P & k as well as Zn foliar spray significantly decrease amino acids and proline contents while potassium was the most effective than both p & Zn foliar spray in this concern.

In addition, increasing chloride level ($Cl:SO_4$ ratio) in irrigation water increased total free amino acids content while didn't affect proline content during two seasons of study.

B- Interaction effect:

The highest levels of total amino acids and proline were always in concomitant to leaves of unsprayed (salt stressed) Aghizi transplants which irrigated with salinized water of higher chloride level during the two seasons of study. The reverse was true with sprayed salinity stressed transplants especially at lower $Cl:SO_4$ ratio of Coronaiki cvs. with potassium and irrigated with salinity water and low chloride level. However, other combinations were in between the aforesaid 2 extremes.

V.II.III.5. Leaf mineral composition:

A- Specific effect:

1- Referring the specific effect of olive cultivar, data obtained during both seasons revealed that Coronaiki cultivar had the richest leaves and exceeded statistically the two other cultivars (Manzanillo and Aghizi) regarding leaf N, P, K, Mg, Fe, Mn and Zn contents from one hand ,but the poorest leaves of the least value of Ca and Na contents from the other. The reverse was true with Aghizi cultivar during the two seasons of study.

2- As for the specific effect of sprayed nutrient elements (P, K & Zn), it is quite Clear that p; k or Zn foliar spray for salt stressed olive transplants statistically increased leaf N, P, K, Mg, Fe, Mn and Zn contents as compared with unsprayed salt

stressed (control) ones while the reverse was true with leaf - Ca and Na contents during two seasons of study.

3- Data obtained revealed that k foliar spray was the most effective for increasing leaf N ; K and Mn while p foliar spray was the superior for leaf p ; Fe and Mg contents. On the other hand foliar spray with any of three nutrients exhibited significantly an obvious reduction in both Ca and Na levels, where the Zn and P showed the most reductive effect for Ca and Na respectively. In addition Zn foliar spray showed the highest value of leaf Zn content.

4- Increasing chloride level ($Cl:SO_4$ ratio) in irrigation water significantly decreased leaf - N, P, K, Fe, Mn and Zn contents but increased leaves Ca and Na of salt stressed olive transplants during the two seasons of study. However, leaf Mg content didn't respond significantly to $Cl:SO_4$ ratio.

B- Interaction effect:

1- A significant response to interaction effect of various combination between olive cultivar, sprayed nutrient element and chloride level ($Cl:SO_4$ ratio) in irrigation water. However, combinations represented (Coronaiki x K x low chloride level); (Coronaiki x P x low chloride level); (Coronaiki x Zn x low chloride level) exhibited the highest leaf (N & K); (P & Mg) and (Fe & Zn), respectively. In addition, unsprayed Aghizi transplants irrigated with 6000 ppm salt solution with high chloride level gave the highest value of leaf Ca & Na contents during two seasons of study.

2- Data obtained revealed that (Unsprayed Manzanillo cultivar x high chloride level), (unsprayed Aghizi cvs. x high chloride level); (Coronaiki cvs. x p x low chloride level) and (unsprayed Coronaiki cvs. x high chloride level) showed the highest values of leaf (N & p); (N, p, K, Fe, Mn & Zn); (Ca & Na) and Mg contents, respectively during the two seasons of study.

V.II.III.6. Anatomical structure.

Leaf and root anatomical structure of olive transplants (Aghazi , Coronaiki and Manzanillo Cvs.)as influenced by saline stress (irrigated with 6000 ppm ; SAR6 and two Cl:SO4 ratio saline solution) and foliar sprays of such depressed plants with P; K and Zn were investigated .Data obtained revealed the following.

V.II.III.6.1.Leaf anatomy:

Microscopic examination displayed that leaf blade thickness was slightly increased in olive transplants of 3 cvs. under saline stress as compared to analogous ones of control(tap water irrigation).Such increase mainly due to the increase in thickness of both upper and lower cuticle & epidermis layers, besides the relative increase in spongy tissue and to some extent palisade tissue , as well as the intercellular spaces. However, p foliar spray resulted in an increase in both spongy and palisade tissues ,especially Aghazi cvs. Moreover , K spray enhanced and increased production of xylems elements (arms &vessels) of mid- rib region , beside leaf blade thickness i.e spongy and palisade tissues, especially Aghazi cvs. the Same trend of K foliar spray was exhibited by Zn spray.

V.II.III.6.2.Root anatomy:

Saline solution increased root periderm thickness of 3 olive cultivars. Meanwhile, the examined root anatomical characteristics i.e, number of (xylem arms of vessels) and diameter /thickness of (xylem vessels; phloem and vascular cylinder) took the other way around, where all were obviously decreased.

On the other hand, P; K and Zn foliar spray of olive transplants grown under saline stress exhibited a very slight reduction in periderm thickness although it was still remained thicker than control (tap water irrigation). On the contrary, P,K and Zn foliar spray increased relatively other anatomical characteristics i.e,(No of xylem arms and vessels) and diameter / thickness of (xylem vessels ; phloem and vascular cylinder).