IV - RESULTS AND DISCUSSION

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A - Effect of salt concentrations, sodium adsorption ratio (S.A.R.) and chloride levels in irrigation water on growth measurements of, Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings:

The data in tables 2,3,4,5 and 6 show that growth measurements expressed as, stem length, increase in stem length, number of leaves, increase in number of leves, number of branches, top to root ratio and leaves, stem, roots and total plant dry weights of Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings.

1 - Effect on stem length:-

From table (2) and Fig(1) it is obvious that stem length and percentage increase in stem length decreased significatly by using saline solutions as compared with those of tap water (control treatment) in all fruit species during 1982 and 1983 seasons. Such decrease was more remarkable with the higher concentration. In this respect, Hayward and Long (1942) found that the total concentration of salts was a major factor in the general growth depression on peach. Hayward and Spurr (1943) concluded that the increased osmotic pressure of saline soil solution tended to restrict the uptake of water by roots on corn. Wilcox et.al (1951) mentioned that salinity of soil solution may affect growth of plants in two ways: 1st the osmotic pressure of the solution may be high enough to limit the availability of water to the plant, or 2nd high concentration of salts in the solution may facilitate the uptake of one or more of the present ions so that an accumulation may result and cause a derangement of the normal metabolism of the plant. Brown et.al.(1953) noticed a differential response to specific salts which appeared to be more important than the effect of the osmotic pressure of the solution on stone fruit. Moreover, Pokroveskay (1954) and 1957) found that in glycophytes both cell division and cell elongation were inhibited with increased salinity.

Antipov (1958) showed that the smallar size of Alfalfa grown in saline areas , was determined more by a decrease in all number rather than by cell size. Nieman (1965) concluded that the number of cells per unit leaf area (Phaseoulus Vulgaris L.) tended to remain constant throughout most of the growth period in both the control and the salt stunted leaves. In addition; Makhija et.al. (1980) found that rising salinity levels (abov 7.5 mmhos/ Cm conductivity of saturation extract) causing growth reduction on guava seedlings. They found that accumulation of CL^- and Na in toxic concentration in plant tissues and nutrient imblance were the main effects of salinity. Recently; Khamis et.al.(1984) on guava and olive, and Behairy et.al.(1984) on Thompson seedless and American grape plants, they found that stem length was depressed by salinity concentrations.

Increasing sodium adsorption ratio (S.A.R.) from 3 to 6 in irrigation water caused a slight decrease in stem length and remarkable decrease in the percentage of the increase of stem length in Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings during 1982 and 1983 seasons. In this respect; EL-Deen et.al. (1979) on olive seedlings, Khamis et.al.(1984) on guava and olive seedlings; Behairy et.al.(1984) on Thompson seedless and American grape; and Abd-EL-Aziz et.al.(1985) on some citrus seedlings, they found that increasing sodium adsorption ratio (S.A.R.) resulted in significant reduction of plant height.

In addition; increasing the level of chloride in irrigation water was not affected in stem length while remarkable and significant decrease in the percentage of the increase of stem length in three fruit species during the tow seasons of sutdy. This results are in harmony with the findings of Abd-EL-Aziz et.al.(1985) in rangpur lime and rough lemon seedlings.

Concerning the effect of interaction between salt concentrations and sodium adsorption ratio (S.A.R.) levels on stem length and the percentage of the increase in stem length, it is clear from table (2) that the effect was slightly decreased in stem length while it decreased in the percentage of the increase in stem length compared with the control in all fruit species during the study. Moreover, the maximum reduction in stem length was obvious at the highest salt concentration with the highest level of S.A.R. in all fruit species during 1982 and 1983 seasons. The same finding were obtained by Abd-EL-Aziz et.al.(1985) . In addition to that, interaction between sodium adsorption ratio (S.A.R.) and chloride levels caused slightly decrease and significantly decrease in both stem length and the percentage increase in stem length respectively, Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings during the two seasons of study except the first season in both Thompson seedless and peach seedlings the decrease was not significant. Moreover the interaction between salt concentrations, S.A.R. and chloride levels on stem length in three fruit species under study was slightly decrease but not significant. This result was confirmed with the findings of Abd-EL-Aziz et.al.(1985) on five citrus rootstocks.

2 - Effect on number of leaves:-

Data from table (3) and Fig(2) clear that number of leaves and the percentage of increase in number of leaves decreased significantly by using different saline solutions as compared with those of tap water (control treatment) in Thompson seedless grape, Meet-Ghamr peach and Holywood plum during 1982 and 1983 seasons. Such decrease was more remarkable with the higher concentration. This results are in confirmity with the findings of Hassan (1974) on some vegetable crops and EL-Deen et.al (1979) on olive seedlings.

Increasing sodium adsorption ratio (S.A.R.) from 3 to 6 in irrigation water caused highly significant decrease in both number of leaves and the percentage of the increase in number of leaves in all fruit species during the two seasons of study. In this respect;EL-Deen, et.al.(1979) found that increasing sodium adsorption ratio resulted in significant reduction of number of leaves of olive seedlings.

In addilion, increasing the level of chloride in irrigation water caused a slight decrease in the number of leaves, while the percentage of the increase in number of leaves was significantly decreas in Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings during 1982 and 1983 seasons.

With respect to the effect of the interaction between salt concentrations and sodium adsorption ratio (S.A.R.) levels on number of leaves and the percentage of the increase in number of leaves, it is obvious from table (3) that the effect was significantly decreased in both number of leaves and the percentage of the increase in number of leaves compared with the control in three fruit species during the two seasons of study except number of leaves in Thompson seedless was decreased but not significantly during 1982 season. Moreover; the maximum reduction in number of leaves was obvious at the highest salt concentration with the highest level of S.A.R. in three fruit species under study.

In additon to that, interaction between sodium adsorption ratio (S.A.R.) and chloride levels caused slightly decrease and significantly decrease in both number of leaves and the percentage increase in number of leves respectively, during 1982 and 1983 seasons. Moreover; the interaction between salt concentrations X chloride levels and salt concentrations X S.A.R. X chloride levels, number of leaves in three fruit species under study was slightly decrease and not significant.

3 - Effect on number of branches:-

It is obvious from table (4) that number of branches decreased significantly by using different saline solutions as compared with those of tap water (control treatment) in Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings during 1982 and 1983 seasons. Such decrease was more remarkable with the higher concentration.

Increasing sodium adsorption ratio (S.A.R.) from 3 to 6 in irrigation water caused highly significant decrease in the number of branches per plant in three fruit species under study during 1982 and 1983 seasons.

In addition; increasing the levels of chloride in irrigation water caused slightly decrease in the number of branches in Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings during 1982 and 1983 seasons.

Concerning the effect of the interaction between salt concentration and sodium adsorption ratio (S.A.R.) levels on the number of branches per plant was significantly decrease compared with tap water (control treatment) in three fruit species during the study table (4). In addition to that, sodium adsorption ratio (S.A.R.) and chloride levels was significantly decreased in the number of branches in Thompson seedless grape, and Holywood plum seedlings while the decrease was not significantly in Meet-Ghamr peach plants during 1982 and 1983 seasons Moreover; the interaction between salt concentration X chloride and salt concentration X S.A.R. X chloride levels, on the number of branches in three fruit species was slightly decrease and not significant during the two seasons of study.

4 - Effect on Top to root ratio:-

The data of top to root ratio are given in Table (4). The data show that ratio gradually decreased significantly with the increase of salt concentrations. The decrease in top to root ratio with increasing salinity has often been observed by Eaton (1942) on different plant species; Bernstein and Pearson (1954) on tomato and pepper plants and Behairy et.al.(1985) on guava and olive seedlings.

With respect to increasing sodium adsorption ratio (S.A.R.) from 3 to 6 in irrigation water decreased top to root ratio in Thompson seedless grape and Meet-Ghamr peach seedlings while the decrease was significantly in plum plants during 1982 and 1983 seasons. These results are in harmony with the findings of Khamis et.al (1984) on guava and olive seedlings.

In addition; increasing the level of chloride in irrigation water had not affected in top / root ratio in Thompson seedless grape, Meet-Ghamr peach and Holywood plum during 1982 and 1983 seasons. Similar results were obtained by Abd-EL-Aziz et.al (1985) on Balady lime seedlings.

Concerning the effect of interaction between salt concentration and sodium adsorption ratio (S.A.R.) levels; S.A.R. and chloride; salinity and chloride, and salt concentration X S.A.R. X chloride, top to root ratio was decreased slightly and not significant in all fruit species during the two seasons of study. Moreover, the maximum reduction in top to root ratio was obvious at the high salt concentration with the high level of S.A.R., the highest level of chloride, the highest level of S.A.R. and chloride.

5 - Effect on leaves and stem dry weight:-

Concerning the leaves and stem dry weight of the plants in the different treatments; the data presented in Table (5) and FigS(3) and (4) show that leaves and stem dry weight of the three tested fruit species corresponding negatively with increasing the concentration of salt added to the irrigation water compared with those of tap water (control treatment) during 1982 and 1983 seasons. Such results appeared to agree with those obtained by Rokba et.al.(1979) on some citrus rootstocks; Khamis et.al.(1984) on guava and olive seedlings; Behairy et.al. (1984) on Thompson and American grape plants; and Abd-EL-Aziz et.al.(1985) on some citrus rootstocks, they found that leaves and stem dry weight were depressed by all the used salinity concentrations.

Increasing sodium adsorption ratio (S.A.R.) from 3 to 6 in irrigation water caused highly significant decrease in leaves dry weight in Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings. The same trend was found in stem dry weight except in Meet-Ghamr peach, the decrease was not statistically significant. This result is in agreement with that reported by Khamis et.al. (1984) on guava and olive; and Behairy et.al. (1984) on Thompson and American grape plants.

In addition, increasing the level of chloride in irrigation water caused a slight decrease in leaves and stem dry weight except leaves dry weight in Thompson seedless grape and Meet-Ghamr peach, the decrease was significant during the second season only. This result agree with the findings of Abd-EL-Aziz et.al. (1985) on some citrus rootstocks.

Regarding to the effect of interaction between salt concentrations and sodium adsorption ratio (S.A.R.) levels on leaves and stem dry weights, it is clear from Table (5) that the effect was slightly decreased but not significant as compared with the control in three fruit species but the decrease was significantly in leaves dry weight during 1983 season and stem dry weight in Thompson seedless grape and Holywood plum druing 1982 and 1983 seasons respectively. In this respect; Behairy et.al. (1984) on Thompson seedless and American grape plants, found that leaves and stem dry weights decreased gradually by increasing salt concentration and S.A.R. ratio, while the maximum dry weight was obtained under tap water treatment.

In addition to that, interaction between sodium adsorption ratio (S.A.R.) and chloride levels, interaction between salt concentration and chloride, and interaction between salt concentration X sodium adsorption ratio (S.A.R.) X chloride levels, leaves and stem dry weights was slightly decrease and not significant in three fruit species during 1982 and 1983 seasons.

6 - Effect on root and total plant dry weight:-

Data from table (6) and Fig(5) and (6), obviously showed that root and total plant dry weights decreased significantly by using different saline solutions as compared with those of tap water (control treatment) in all fruit species under study during 1982 and 1983 seasons. Such decrease was more remarkable with the higher concentration. This result is similar to that reported by Khamis et.al.(1984) on guava and olive seedlings; Abd-EL-Aziz et.al. (1985) on some citrus rootstocks; Sharaf et.al.(1985) on Thompson seedless and American grape plants, and Behairy et.al.,(1985) on guava and olive seedlings.

With respect to increasing sodium adsorption ratio (S.A.R.) from 3 to 6 in irrigation water there was a significant decreas in root and total plant dry weights in three fruit species during the two seasons of study, except root dry weight in peach and plum seedlings, in 1982 season, where the decrease was not low enought to be significant. The same trend was found by Khamis et.al.(1984) on guava and olive; Behairy et.al., (1984) on Thompson seedless and American grape plants, and Abd-EL-Aziz et.al., (1985) on some citrus species.

In addition, increasing the level of chloride in irrigation water decreased significantly root and total plant dry weight in Thompson seedless grape and Holywood plum plants during the two seasons of study, while it was decreased but not significantly in peach and plum seedlings.

Concerning the effect of interaction between salt concentrations and sodium adsorption ratio (S.A.R.) levels on root and total plant dry weights, it is obvious from Table (6) that the effect was decreased in all fruit species compared with those of tap water during the study. This result is in agreement with that mentioned by Behairy et.al., (1984). In addition to that, interaction between sodium adsorption ratio and chloride, root and total plant dry weight decreased but not significantly in all fruit species except total plant dry weight in Thompson seedless was significantly decrease. Moreover; interaction between salinity and chloride, and interaction between salinity X S.A.R. X chloride, slightly decrease root and total plant dry weight but not significantly in the three tested fruit species while the maximum dry weight was obtained under tap water (control treatment) during 1982 and 1983 seasons.

B - Effect of salt concentrations, sodium adsorption ratio (S.A.R.) and chloride levels in irrigation water on leaf chlorophyll content of Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings:-

One of the main factors controlling carbohydrate metabolism in plants is the chlorophyll content. Yet the study of the effect of salinity on chlorophyll content is of major importance to plant physiologists. Data obtained in the present study of chlorophyll (a) and -b) content expressed as mg/g fresh weight of leaves, are shown in Tables (7) and (8). Results revealed that there was a gradual decrease in leaf chlorophyll content at the salinity level in irrigation water was increased of all studied samples. Such chlorophyll depression was more pronounced at S.A.R; 6 than at S.A.R. 3 in August samples in three fruit species. These results are in agreement with those previously reported by Baslavskaya and Syroeskina (1973) and Harward et.al., (1956) who found an apparent reduction of chlorophyll in leaves of potato plants treated with chloride salts. The effect of sodium chloride and sodium carbonate on chlorophyll in leaves of cabbage and lettuce, indicated that increasing concentration of either NaCL or $Na_2 CO_3$ from 0.5 to 6 atmospher resulted in a remarkable depression in the mentioned pigments (Kim, 1958).

Carter and Myers (1963) worked on grapefruit trees irrigated with water containing either Na_2SO_4,NaCL and $CaCL_2$. Their data showed that all salts induced about 50 % decrease in chlorophyll content. They suggested a similar action in decreasing the concentration of chlorophyll and caroten pigment. The reduction in pigment content caused by the salts may be cause leaf structural changes. Similar results were obtained by Kanwar and Bhambota (1968) in sweet orange, and by Taha, (1971) in tomato; Mostafa Fadl and Seif Sari EL-Deen (1979) mentioned that salinity at 4000 p.p.m. depressed chlorophyll (a),(b) and caroten content particularly at S.A.R. 18. Petrosjan et.al.(1979) found that a decrease was observed in leaf chlorophyll, and leaf photosynthesis in grapevines growing in soil containing Na ions in the range 5.6-6.2 meq/ 100 g soil.

Taher (1983) found that increasing the salt concentrations in irrigation water decreased total leaf chlorophyll content as compared with those of the control for sour ornage, cleopatra mandarin and rough lemon seedlings.

With respect to the effect of sodium adsorption ratio from 3 to 6, chloride levels, interactions between salinity X S.A.R., S.A.R. X chloride, salinity X chloride and salinity X S.A.R. X chloride showed that leaf chlorophyll content was slightly decrease but not significantly noticable in three fruit species under this study.

C - <u>Effect of salt concentrations, sodium adsorption ratio (S.A.R.) and chloride levels in irrigation water on leaf and root mineral composition of Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings:</u>

The data concerning the effect of different salt concentrations, sodium adsorption ratio (S.A.R.) and chloride levels in irrigation water on N,P,K,Na, Ca and Mg leaf and root content of Thompson seedless grape, Meet-Ghamr peach and Holywood plum seedlings are presented in tables (9 to 14).

1 - <u>Leaf and root nitrogen content:-</u>

Concerning the effect of different salt concentration in the irrigation water on leaf and root nitrogen content of the three fruit species, the data of 1982 and 1983 seasons showed that

Salinity at any levels depressed leaf and root nitrogen content comparing with those of the control. (Nitrogen status reflects the physiology of the whole plants as well as its interaction with its surroundings) under saline conditions there were disturbances in the nitrogen metabolism in plants. These results are similar to those obtained by Gauch and Wedleigh (1945) on bean plants; Petrosjan et.al.(1967) on perrenial crops; Abd EL-Messih et.al.,(1979) on some citrus stock seedlings; Abd-EL-Aziz et.al., (1985) on guava and olive seedlings; Sharaf et.al., (1985) on Thompson seedless and American grape, and Behairy et.al., (1985) on guava and olive seedlings. Further more, other studies carried out by Gauch and Eaton (1942) on barley plants: Hayward and Long (1943) on tomato; and Wadleigh and Ayers (1945) on bean plants, indicated that salinity increased total nitrogen content of plants. On the other hand, Daito (1967) reported that salt treatments did not affect leaf N content of satsuma orange leaves; Further more, Taher, (1983) reported that leaf nitrogen content in sour orange, cleopatra mandarin and rough lemon did not follow a definite trend when treated with different concentrations of salinity. Moreover, leaf and root nitrogen content decreased significantly by increasing sodium adsorption ratio (S.A.R.) from 3 to 6. In this respect; Abd-EL-Aziz et.al.,(1985) on guava and olive; and Sharaf et.al. (1985) on Thompson seedless and American grape found that leaf nitrogen content was slightly decreased by increasing sodium adsorption ratio (S.A.R.) but not significantly.

With respect to the effect of chloride levels on leaf and root nitrogen content, data from Table (9) show clearly that was slightly decrease but not significantly in three fruit species during 1982 and 1983 seasons. This result is in harmony with that reported by EL-Ashram, et.al., (1985) on some citrus rootstock seedlings.

2 - Leaf and root phosphorus content:-

Data from table (10) indicated generally that salinity treatments decreased leaf and root phosphorus concentration but the decrease was statistically significant only in Meet-Ghamr peach seedlings during 1982 and 1983 seasons. This result is in agreement with those reported by Jindal et.al. (1979) on mango; Mohamed Ali, (1979) on Thompson seedless grape, Sharaf et.al. (1985) on Thompson seedless and American grape, and Behairy et.al.(1985) on guava and olive seedlings. On the other hand, leaf and root phosphorus concentration did not differ by either increasing sodium Adsorption ratio (S.A.R.) from 3 to 6 or chloride levels. These results are confirmed with Bernstein et.al., (1956); EL-Ashram et.al., (1985), and Sharaf et.al.,(1985) on stone fruit trees, some citrus rootstock seedlings and guava and olive seedlings respectively.

3 - Leaf and root potassium content:-

Data from table(11) obviously showed that leaf & root potassium content decreased significantly by using different saline solutions as compared with those of tap water (control treatment) in three fruit species under study. Such decrease was more remarkable with the higher concentration. This result is confirmed with the findings of Gorton and Cooper (1954), who stated that increasing Ca content of irrigation water depressed K concentration of grapefruit leaves. Pearson et.al.(1957) found that increasing levels of salinity, as NaCL in irrigation water caused a decrease in leaf potassium content., Moreover; same findings were obtained by Taha (1971) on Tomato plants; Paliwal and Maliwal (1972) in Okra; EL-Gizawy (1973) on strawberry;Mohamed Ali (1979) in Thompson seedless grape; Abdel-Messih et.al.(1979) on citrus rootstocks seedling; Khamis and Darwish (1981) on citrus plants; Sharaf et.al.(1985) on Thompson seedless and American grape; and Behairy et.al.,(1985) on guava and olive seedlings. Moreover; leaf and root K concentration was decreased by increasing sodium adsorption ratio (S.A.R.) the decrease was significantly in leaf K Thompson seedless and peach leaves during 1982 season. In this respect, Bower and Wedleigh (1949) reported that increasing the exchangeable Na percentage of the substrate resulted in a decrease plant K content.

4 - Leaf and root sodium content:-

From table (12) results clearly revealed that leaf and root sodium percentage was clearly proportional to the degree of salinity in irrigation water Salinity at any level level caused significant increase inleaf and root sodium content. These results are in accordance with the findings EL-Gizawy, (1973) on strawberry; Abdel-Messih, et.al., (1979) on some citrus rootstock seedlings; Makhija et.al.(1980) on guava seedlings; Khamis and Darwish, (1981) on citrus seedlings; Sharaf et.al.,(1985) on Thompson seedless and American grape, and Behairy et. al., (1985)on guava and olive seedlings. Moreover, data clearly showed that leaf and root sodium content slightly increased by increasing S.A.R. although, this increase so small statistically to be negligable in three fruit species during 1982 and 1983 seasons. This is in agreement with the findings of Abd-EL-Aziz et.al., (1985) on guava and olive seedlings; EL-Ashram et.al.,(1985) on some citrus seedlings; and Sharaf et.al.,(1985) on Thompson seedless and American grape.

Never the less, leaf and root sodium content was not affected by increasing chloride levels in irrigation water in the three fruit species under study during 1982 and 1983 seasons. These results are similar to those obtained by EL-Ashram et.al. (1985) on some citrus rootstock seedlings.

5 - Leaf and root calcium content:-

Data from table (13) indicated that the pattern of Ca distribution showed that leaves and roots of plants irrigated with tap water contained the lowest Ca concentration, when compared with those of other salt treatments in all fruit species under study. However, plants received lowest salt level slightly higher leaf and root Ca percentages than those of the control. These results are similarly to that obtained by Cooper et.al.,(1952) on citrus. They found that salt (NaCL and $CaCL_2$ on milliequivalent basis) treatments increased the calcium content of the leaves of valencia orange and Shary Red grapefruit grafted on both cleopatra mandarin and sour orange rootstocks. Makhija et.al.,(1980) on guava seedlings, found that rising salinity levels increased leaf Ca content.

Moreover; leaf Ca content increased by increasing sodium adsorption ratio (S.A.R.) from 3 to 6 but this increase was not significant in root Ca content during 1982 and 1983 seasons in all fruit species. In this respect, Bower and Wadleigh, (1949), stated that increasing the exchangeable sodium percentage of the substrate resulted in a decrease accumulation of Ca in the plants. Moreover; leaf and root Ca content was slightly increase by increasing sodium adsorption ratio (S.A.R.) or chloride levels in irrigation water in all fruit species under study.

6 - Leaf and root Mg content:-

Data from Table(14) obviously showed that leaf Mg content decreased significantly by using different saline solutions as compared with those of tap water in three fruit species under study, while root Mg content was no definit trend. These findings were in partially accordance with Bernstein and Ayers (1953 a,b). They stated that magnesium was relatively unaffected in roots and tended to decrease somewhat in tops in carrots and onions. Moreover; Cooper et.al.(1952); and Daito (1957), found no differences in Mg accumulation in citrus leaves as a result of different salinity treatments. On the other hand, leaf and root magnesium concentration slightly decrease but not statistically significant. Via increasing sodium adsorption ratio (S.A.R.) or chloride levels in three fruit species. In this respect, Bower and Wadleigh, (1949), concluded that increasing exchange able sodium percentage of the substrate resulted in a decreased accumulation of magnesium in the plants.

Generally, it is well noticed from the statistical analysis that most values of interactions between salt concentration X sodium adsorption ratio (S.A.R.); S.A.R. X chloride levels; solt concentration X chloride levels, and salt concentration X S.A.R. X chloride levels were not statistically significant in all cases in both seasons of study. Thus, these values of interactions were not involved in the present investigation.