RESULTS AND DISCUSSION

Results and discussion will be discussed under the following topics:

A. GROWTH STAGES

1. Effect of seasons:

Table (3) shows the influence of seasons on growth criteria and juice quality of sugar beet at the various growth stages.

Results given pointed out that root dimensions in terms of length and diameter as well as leaves fresh weight/ plant were insignificantly affected by the effect of growing seasons, except root length in the third stage (180 days from sowing). This finding was fairly true at the different growth stages (120, 150 and 180 days from sowing). However, root fresh weight/plant was statistically higher in the second season at 120 and 150 days from sowing.

These results were true at 120 and 150 days from sowing, meanwhile difference between seasons did not reach the level of significance in the third age in its effect on this trait. Once more, it would be observed that the above mentioned morphological characters was positively affected by the growing seasons, the highest mean value of root fresh weight/plant was recorded in

the second season. The superiority effect of the second season in this trait may be due to prevalent condition.

Concerning seasonal effect on juice quality of sugar beet, the collected data cleared that the mean values of total soluble solids (TSS %) significantly affected by the growing seasons. This result was true in the three growth periods. The highest mean values of TSS % were recorded in the 1^{st} season.

This result may be due to the difference in temperature between the two seasons on January where the sample has been taken (20.0 & 17.3 ^{o}C for air temperature) and (15.9 & 10.1 ^{o}C for soil temperature) at the 1^{st} and 2^{nd} seasons, respectively.

Regarding to the influence of growing seasons on sucrose percentage, it could be noted that this trait was significantly higher in the first growing season at 120 days from sowing only.

Meanwhile, this effect was insignificant at the second and third growth stages.

As to, the effect of growing season on juice purity percentage, results given in Table (3) show that purity percentage was significantly affected by growing season in the first growth stage (120 days from sowing) as well as in the third stage (180 days from sowing). However, this effect was insignificant in the second growth stage (150 days from sowing).

Regardless the significant effect, it could be noticed that as the sugar beet plant tended toward the maturity, the mean values of purity percentage tended to increase. This observation may be attributed to the increase in the value of sucrose as the plants tended to maturity stage (Table, 3).

2. Varietal performance:

a. Growth criteria:

Data in Table (4) show the effect of sugar beet varieties on root length, root diameter, root fresh weight and top fresh weight/ plant at 120, 150 and 180 days from sowing in the two growing seasons and their combined.

Results revealed that the differences among the tested varieties were significant with respect to the above mentioned characters at the three sampling dates, except top fresh weight at 120 and 150 days from sowing and root diameter in the second season at the three stages.

Montebianco variety gave the highest values for all characters followed by Kawemira, while Gloria variety gave the lowest ones. These results were true in the two seasons and their combined. These differences may be due to varietals performance which correlated with genetically makes up effect.

The same trend was obtained by **AL-Labbody (2003), Osman *et al.* (2003)** and **Shalaby (2003)**.

b. Juice quality:

Table (5) shows that total soluble solids, sucrose and purity percentages (juice quality traits) were almost significantly affected by the examined varieties at the three growth stages.

Montebianco recorded the highest values of total soluble solids, but the variety Gloria gave the lowest values. On the contrary Gloria variety recorded the highest values of sucrose and purity percentages, and Montebianco gave the lowest values at the three growth stages.

These results are in line with **EL-Geddawy (2001), AL-Labbody (2003)** and **Shalaby (2003)**.

3. Effect of interaction between varieties and seasons:

The effect of the interaction between varieties and seasons was insignificant for top fresh weight in the three samples, root length and diameter in the first and second stages and root fresh weight in the third stage (Table, 4) revealing that varieties constant from year to year for these traits.

On the other hand, the effect of interaction between variety and seasons was significant for root length and root

diameter in the third stage and root fresh weight in the first and second stages. This result indicates that the performance of these varieties differed from season to another i.e. greatly affected by climatic changes.

Data in Table (5) show the effect interaction between varieties and seasons was not significant for total soluble solids, sucrose and purity percentage at the three stages indicating that stable of the performance of these varieties from season to another.

4. Effect of boron fertilizer levels:

a. Growth criteria:

The average values of growth criteria i.e. root length, root diameter, root fresh weight and top fresh weight/plant at 120, 150 and 180 days after sowing as affected by boron levels in two growing seasons and their combined are presented in Table (6).

The highest values of the above mentioned characters at the three growth stages were obtained by applying 1.00 kg B/fed.

Data indicate that the root dimensions were significantly increased as the boron level increased from 0.50 to 1.00 kg B/fed. This result was true in the two seasons and their combined for the different growth stages.

The same trends were obtained by **Osman (1997)** and **Nemeat-Alla (2004)**.

The increases in the root dimensions with the increase of boron fertilizer may be due to the effective role of boron on growth in terms of the number and/or the size of cells.

Concerning root fresh weight/plant (RFW/plant), it could be noted that increasing boron level up to 1 kg B/fed significantly increased RFW/plant in the first and second seasons as well as in the various growth stages except at 150 days in the second season whereas the difference between boron levels was insignificant with respond to its effect on this trait. Similar results were obtained by **Mohamed (1993)** and **Osman *et al.* (2004)**.

Results given in Table (6) indicate that top fresh weight/plant was insignificantly affected by boron fertilizer in the first and second seasons and their combined at 120 and 150 days from sowing, however increased was significantly with the increase in the applied dose of boron up to 1.00 kg B/fed at the plant age 180 days from sowing. These results are in line with **Saif (1991)**.

b. Juice quality:

Table (7) shows the effect of boron fertilizer levels on total soluble solids, sucrose and purity percentages.

Data indicated that the total soluble solids percentage of sugar beet roots recorded the highest significant values under unfertilized treatment, but this finding was almost true in the various growth stages of the two seasons and the combined over the two seasons.

With respect to sucrose and purity percentages, the results obtained cleared that increasing the applied dose of boron increased the values of sucrose and purity percentages. This increment was statistical at the various growth stages of the seasons and their combined except when the plant aged 120 days from sowing the differences between boron levels in their effect on these measurements did not reach the level of significance.

These results coincide with those obtained by **Jazczolt (1998)** and **Osman *et al.* (2003)**.

The relative increase in sucrose values mainly due to the enhanced role of boron in sugar accumulation.

5. Effect of interaction between boron fertilizer levels and seasons:

Table (6) shows the effect of the interaction between boron fertilizer levels and the growing seasons.

Results revealed that the studied growth characteristics in terms of root dimensions, root and top fresh weight/plant insignificantly affected by the interaction between boron fertilizer and growing season.

The interaction between boron levels and the growing season was statistically in their influence on root fresh weight/plant.

Concerning sugar beet juice quality, the available data in Table (7) show that the percentages of sucrose and purity significantly affected by the interaction between boron fertilizer levels and the growing seasons at the early growth stage only i.e. 120 days from sowing, however, this effect was insignificant for TSS% at the various growth stages and for the percentages of sucrose and purity at 150 and 180 days from sowing.

6. Effect of molybdenum fertilizer levels:

a. Growth criteria:

Results given in Table (8) show that root dimensions positively responded to the additional dose of molybdenum application.

These findings were completely true in the two growing seasons and their combined at the different growth stages. Application of 0.50 kg Mo /fed recorded the highest values of root length and diameter. These results are in agreement with those obtained by **Nemeat-Alla (1997)**.

Concerning the effect of molybdenum treatment on the values of root and top fresh weight/ plant, the results appeared that increasing the applied dose of molybdenum attained a relative increase in these traits. These effects were significant in the two growing seasons and their combined at the various growth stages except the second season (150 days from sowing) for top fresh weight, the differences between molybdenum treatments did not reach to the level of significance.

b. Juice quality:

Data presented in Table (9) show that the values parameters of quality statistically affected by the studied levels of molybdenum fertilizer.

Regarding total soluble solids, it could be noted that these on inverse response in the values of TSS% as a result to the increase in the levels of molybdenum fertilizer. These results may indicate that these are no effect on the values of TSS% due to molybdenum element.

As to the influence of molybdenum fertilizer on both of sucrose and purity percentages, the results pointed out that increasing the applied doses of molybdenum element produced gradual and statistical increments in the values of sucrose and purity percentages. Adding 0.50 kg Mo/ fed attained the highest significant values of both measurements in the three stages, while, adding 0.25 kg Mo/fed attained the highest value of

sucrose percentage at 120 days from sowing in their combined. The same trend was obtained by **Nemeat-Alla (1997)**.

The above mentioned results were true in the two growing seasons and their combined under the different growth stages.

7. Effect of interaction between molybdenum fertilizer levels and seasons:

Data in Table (8) indicate that the effect of the interaction between molybdenum fertilizer levels and seasons on root length, diameter and top fresh weight was significant in the first and second growth stages (120 and 150 days from sowing). Root length and diameter were significant in the third growth stage (180 days from sowing).

Juice quality of sugar beet roots, total soluble solids percentage was significant in the first and third growth stages. While, the values of sucrose and purity percentages were insignificantly changed by the effect of interaction between molybdenum fertilizers and seasons in the first, second and third growth stages (Table, 9).

8. Effect of interaction between varieties and boron fertilizer levels:

Results in Tables (10 and 11) show that the effect of interaction over the two seasons between varieties and boron fertilizer levels had a significant effect on root fresh weight/plant at 120 days from sowing and top fresh weight/plant at 120 and 150 days from sowing.

The highest value of root fresh weight was obtained by adding 1.00 kg B/fed with Montebianco variety, while the lowest value of root fresh weight was recorded with 0.50 kg B/fed with Gloria variety (Table, 10).

Concerning top fresh weight/plant, the highest value was seen in the first and second growth stages by applying 1.00 kg B/fed with Kawemira variety, while the lowest value of top fresh weight was shown by 1.00 kg B/fed with Montebianco variety (Table, 11).

9. Effect of interaction between varieties, boron fertilizer levels and seasons:

The available data show that the interaction between varieties, boron and seasons was significant at 120 days from sowing (Tables, 10 and 11).

B. AT HARVEST

1. Effect of seasons:

Results given in Table (12) show the influence of seasonal effect on growth criteria and juice quality. The collected data revealed that growth criteria in terms of root length, root diameter, root and top fresh weight/ plant appeared insignificant influence by the growing seasons. However, the differences between the two growing seasons with relation to their influence on juice quality measurements were significant for total soluble solids percentage and purity percentage. This finding is true from scientific view, that because both of them greatly were affected by changing in soil nutrition and the prevalent condition, whereas it could be noted that the insignificant effect of seasons on the values of sucrose percentage assured that this trait mainly is affected by gene- make up rather than environmental condition.

Data presented in Table (13 and 14) show seasonal effect on the values of micro and macro-elements in the different parts of sugar beet plants.

It could be noted that the content of root, petiole and blade were not affected by the growing season with respect to their content from the micro (boron and molybdenum) and macro (nitrogen and potassium) elements in Tables (13 and 14) except the values of nitrogen percentage in sugar beet roots and

sodium percentages in sugar beet blade (Table, 14) the effect of seasons on those measurements was significant.

Results given in Table (15) reveal the influence of the growing seasons on roots, sugar and top yield of sugar beet crop at lowest the collected figures cleared that these traits were insignificantly affected by the growing seasons.

2. Varietal performance:

a. Growth criteria:

Results given in Table (16) show that the examined sugar beet varieties statistically differed in their growth characters i.e. root and leave fresh weight/plant.

Concerning root dimensions the available figures show that Montebianco sugar beet variety had the tallest root dimensions and surpassed Kawemira and Gloria whether in the single season or their combined. However, it could be noted that this superiority was statistically in the two seasons and their combined for root length and root diameter in the first season and the combined over the two seasons. Meanwhile the differences between the studied varieties for root diameter in the second season did not reach the level of significance.

Once more, the collected results Table (16) clearly show that there are statistical differences between the examined sugar beet varieties with respect to the values of root and top fresh weight/plant in the two seasons and their combined. The highest values of these traits were recorded for Montebianco sugar beet variety followed by Kawemira then Gloria.

As for, the interaction effects between the examined varieties and the two growing seasons, results obtained indicate that the effect of this interaction was insignificant for root length and root and leaves fresh weight/ plant. However, it was significant for root diameter.

It could be noted that sugar beet variety Montebianco recorded the highest root dimensions as well as the highest values of fresh weight of root and leaves per plant. This finding was true in the two seasons and their combined.

These results are in line with **AL-Labbody (2003), Osman *et al.* (2003)** and **Ali (2005)**.

b. Juice quality:

Data in Table (17) show varietal effects on juice quality measurements of sugar beet plants. The studied sugar beet varieties were significantly differed in total soluble solids, sucrose and purity percentages in both seasons and their combined. It could be noted that sugar beet variety Montebianco attained the highest value of total soluble solids percentage in the two seasons and their combined. These results coincide with those obtained by **Shalaby (2003)** and **Ali (2005)**. However, the same variety recorded the lowest values of sucrose and purity

percentage as compared with the other two varieties. Meanwhile, sugar beet variety Gloria produced the highest values of sucrose and purity percentages in the two seasons and their combined. These results coincide with those obtained by **EL-Geddawy (2001)**, **AL-Labbody (2003)** and **Ali (2005)**.

The superiority of sugar beet variety Gloria in purity percentage over the two varieties was mainly due to its high value of sucrose percentage.

Moreover, sugar beet variety Kawemira attained a medium values between Montebianco and Gloria in respect to juice quality parameters. The results obtained revealed that sugar beet varieties obviously varied with respect to their content of sucrose consequently their purity percentages and theirs difference mainly due to their different in maturity states which attributed by gene-make up influence.

c. Chemical constituents:

Data in Table (18) show the concentration of boron in the plant organs in terms of root, petiole and blade of the studied sugar beet varieties. The results elucidated that boron content of leaf petiole and blade were significantly varied by the studied genotypes. On the contrary, boron root content insignificantly affected by the examined varieties. It could be remarked that sugar beet variety Gloria recorded the highest boron concentration in root; petiole and blade as it clearly show in the single season and/or the combined of the two seasons.

Once more, the results given in Table (19) clear that the studied sugar beet varieties did not differ significantly in molybdenum concentration in the various parts of sugar beet plants roots, petioles and blades these finding were completely true in the two seasons and their combined.

Concerning nitrogen percentages in the different parts of sugar beet plant, the available data in Table (20) distinctly reveal that the differences between the examined genotype in respect to their content of nitrogen almost did not reach the level of significance, except in the first season for roots and petioles and for the combined over the two seasons for sugar beet root, the differences between varieties with respect to nitrogen percentages were statistically. These results coincide with that obtained by **Shalaby (2003)**.

Regarding the collected data in Table (21) it could be noted that potassium concentration in sugar beet roots of the studied varieties were significant in the first and the second seasons and their combined.

However, the differences between varieties with respect to leaf's petiole content were significant in the first season and the combined data. Also, insignificant differences between varieties were obtained for potassium concentrations in blade. And regardless the significantly effect, it could be noted that sugar beet variety Montebianco almost recorded the highest values of potassium percentage for the various parts of the plant. Montebianco variety gave the highest values for all characters followed by Kawemira, while Gloria variety gave the lowest ones. These results coincide with that obtained by **Shalaby (2003)**.

Results in Table (22) reveal that the studied sugar beet varieties were significantly differed in sodium concentration of their roots in the first season and in the combined over the two seasons, meanwhile were insignificant in petioles and blades. These results coincide with that obtained by **Shalaby (2003)**.

d. Yield and its components:

Data collected in Table (23) clear the effect of the examined sugar beet varieties on root, top and sugar yields in the two seasons and their combined. Start with, the obtained results show that the examined genotypes widly and significantly varied in their effect on the sugar beet yield.

The relative increase in the average of the two seasons in root yield of sugar beet variety Montebianco amounted by 4.86 % and 7.18 % over that Kawemira and Gloria varieties, respectively. However, this increment in top yield amounted by 5.95 % and 24.41 % comparing with the same varieties.

The same trends were obtained by **EL-Geddawy (2001)**, **AL-Labbody (2003)** and **Ali (2005)**.

As to, the influence of the studied varieties on sugar yield, the recorded figures in Table (23) show that the sugar yield

record on inverse relationship with respect to the effect of sugar beet varieties on roots and tops fresh yield. The lowest sugar beet yield variety (Gloria) was the highest, sugar yield and vice versa. The highest root yield (Montebianco) was the lowest sugar yield. The distinguished increase in the values of sugar yield for the lowest root yield variety, mainly due to the high value of sucrose percentage for this variety.

A speculative view to the results of sugar yield, it could be deduced that the relative increase in sugar yield of Gloria variety as a result to its highest value sucrose percentage amounted by 11.49 % and 20.94 % over those of Kawemira and Montebianco sugar beet varieties respectively for the average of the two seasons. The same trends were obtained by **EL-Geddawy (2001)**, **AL-Labbody (2003)** and **Ali (2005)**.

Concerning roots and tops fresh weight yields, it could be noted that sugar beet variety Montebianco surpassed the other two varieties and recorded the highest root yield/fed followed by Kawemira, while Gloria variety gave the lowest one. This finding was true in the two seasons and their combined (Table,23).

This result may be considered a good indication for the growers and the policy maker take in consideration the relative importance of sucrose percentage in addition to root yield to decrease the gap of sugar between the consumption and the production.

3. Effect of interaction between varieties and seasons:

Results showed that except root diameter, nitrogen concentrations in root and petiole, as well as sodium content in root were significantly affected. The interaction between varieties and seasons was insignificantly affected on the most criteria (Tables, 16-23).

4. Effect of boron fertilizer levels:

a. Growth criteria:

Data collected in Table (24) clear the effect of boron fertilizer levels on root dimensions and root, top fresh weight/ plant of the examined sugar beet varieties. Results obtained clarified that the above mentioned criteria positively and significantly responded to the applied boron fertilizer levels.

Concerning the average root length and diameter of the combined over the two seasons, increasing boron supply from zero (control) to 0.50 and 1.00 g B/fed caused a significant increase in root length amounted to 2.24 and 0.89 cm, corresponding to 1.42 and 0.69 cm in root diameter, successively. The same trends were obtained by **Osman *et al.* (2003)**, **Nafei (2004)** and **Osman *et al.* (2004)**.

Once more, the results obtained in Table (24) clear that applied 1.00 kg B/fed raised increment in the values of the average of the two seasons amounted by 3.07 and 0.76 % root fresh weight/plant corresponding 22.22 % and 6.10 % for top fresh weight/plant compared with control or application of 0.50 kg B/fed, respectively.

Fresh weight/plant of root in the average of the two seasons had the greatest fresh weight of root/plant and outyielded control and 0.50 kg B/fed by 29.10 and 7.40 gm, respectively. In this respect, **Osman (1997)** and **Osman *et al.* (2004)** mentioned that raising boron level applied to sugar beet plants increased root fresh weight. The results showed no significant difference in this character between 0.50 and 1.00 kg B/fed in the two seasons and their combined.

b. Juice quality:

Data in Table (25) show the effect of boron levels juice quality measurements in terms of total soluble solids, sucrose and purity percentages in the two growing seasons and their combined.

Results showed that total soluble solids percentage was statistically affected by the applied levels of boron fertilizer, increasing the supplied dose of boron negatively affected on the values of TSS %. Also, it is well known the direct role of boron element in sucrose translocation between plant organs, it well be not enough to depend upon the values of total soluble solids percentage only with respect to juice quality.

A throw some lights on the effect of boron fertilizer on the values of sucrose and purity percentages. It could be noted that the response of both measurements to the additional application of boron fertilizer was inverse to the response of TSS%.

This result assured the important and real role micro-elements such as boron in sucrose translocation.

Increasing the applied dose of boron fertilizer caused a significant increase in the values of sucrose and purity percentages. These results were true in both seasons and their combined.

It could be deduced that applying 1.00 kg B/fed attained the lowest value of total soluble solids percentage as shown in the combined analysis. In addition, the same boron level gave the highest values of sucrose and purity percentages followed by 0.50 kg B/fed and control. The same trends were reported by **Jaszczolt (1998)**, **Saif (2000)**, **Osman *et al.* (2003)** and **Nafei (2004)**.

c. Chemical constituents:

Data in Table (26) show the influence of boron fertilizer concentration of boron in root, petiole and blade. Results elucidated that boron contents in root, leaf petiole and blade were varied significantly and were increased as the applied dose of boron fertilizer increased from zero to 0.50 and up to 1.00 kg

B/fed. This finding was true in the both seasons and their combined. Similar results were obtained by **Domska (1996)**.

Data given in Table (27) obviously show that increasing boron fertilizer up to 1.00 kg B/fed attained a significant increase in the values of molybdenum concentration in the root tissues.

This finding was true in the two seasons and their combined. However application of 0.50 kg B/fed was enough to produce the highest concentration of molybdenum in the petiole and blade of sugar beet leaves. Moreover, it could be noted that this influence was statistically only in the first season and their combined of the two seasons with respect to molybdenum concentration in the petiole tissue, meanwhile the differences between boron levels and their influence on molybdenum concentrations were not enough to reach the level of significance in blade.

Results in Table (28) reveal that nitrogen concentrations in the different parts of sugar beet plant i.e. root, petiole and blade were insignificant in the two seasons. Similar results were obtained by **Domska (1996)**.

As to potassium and sodium concentrations in the different parts of sugar beet plants almost appeared insignificant response to the studied levels of boron fertilizer in the two growing seasons and their combined. However, potassium percentage in root and sodium percentage in petiole responded significantly to the applied boron fertilizer levels in the second season (Tables, 29 and 30). Similar result was obtained by **Domska (1996)**.

d. Yield and its components:

Results given in Table (31) show the influence of boron fertilizer on the root, top and sugar yield/fed.

The available results in Table (31) elucidate that there was a positive response in the values of root yield to the applied levels of boron fertilization. This finding was completely true in both seasons and their combined. However, it could be noted that both of boron element levels surpassed check treatment statistically. Meanwhile the difference between the examined levels of boron i.e. 0.50 and 1.00 kg B/fed did not reach the level of significance in both seasons and their combined. Once more, the additional increase in the value of root yield as a result to apply 0.50 kg B/fed amounted by 2.47 %, 1.96 % and 2.18 % in the first, second season and their combined respectively, Corresponding 3.18 %, 2.81 % and 2.96 % when increased the level of boron fertilizer to 1.00 kg B/fed. The same trends were obtained by **Nafei (2004)** and **Osman *et al.* (2004)**.

As to the effect of boron fertilizer levels on the sugar yield/fed. Figures obtain in Table (31) pointed out that sugar yield was distinctly and positively responded to boron fertilizer application. This response was fairly true and significant in the two growing seasons and their combined.

With respect to the additional benefit to boron application, it could be noticed that the additional increment in sugar yield as a results to application of 0.50 kg B/fed reached 4.43 %, 3.77 % and 4.00 % for the first and second seasons and their combined respectively, corresponding to 7.61 %, 7.12 % and 7.36 % when the applied dose of boron fertilizer was 1.00 kg B/fed. These results coincide with those found by **Enan (2004)** and **Nafei (2004)**.

Concerning the influence of boron element on yield of top fresh weight, it was significantly increased as the applied dose of boron increased. Application of 1.00 kg B/fed recorded the highest significant value of top fresh weight yield. Both of the used levels of boron fertilizer i.e. 0.50 and/or 1.00 kg B/fed surpassed check treatment (unfertilized treatment) with respect to top fresh weight yield. This finding was true in the two seasons and their combined. The amount of increment in the value of top fresh weight yield of the combined over the two seasons amounted by 13.82 % and 20.12 % over control by increasing the supplied level of boron to 0.50 and 1.00 kg B/fed successively. These results coincide with those found by **Enan (2004)** and **Osman *et al.* (2004)**.

5. Effect of interaction between boron fertilizer levels and seasons:

Data show that the studied characters were insignificantly affected by the effect of interaction between boron fertilizer levels and seasons, except, root diameter boron in root and petiole, molybdenum concentration in root and petiole and potassium percentages in root (Tables, 25-31).

6. Effect of molybdenum fertilizer levels:

a. Growth criteria:

Data in Table (32) clear the effect of molybdenum fertilizer levels on root dimensions root and top fresh weight at harvest.

Results clarified the above mentioned root and top criteria in terms of root length and diameter as well as root and top fresh weight/plant were statistically and positively affected by molybdenum fertilizer levels. It could be remarked that these traits whether in the two seasons and/or their combined gradually were increased as molybdenum levels increased from zero to 0.25 up to 0.50 kg Mo/fed. These results coincide with those found by **Nemeat-Alla (1997)**.

Regard to the combined analysis results of the two seasons showed that addition of 0.50 kg Mo/fed gave the tallest and the thicknest roots, as well as greatest root and top fresh weight and surpassed 0.25 kg Mo/fed and check treatment by 3.55 and 1.77 cm in length; 1.47 and 0.65 cm in diameter; 51.80 and 23.50 gm in root fresh weight and 87.60 and 44.20 gm in top fresh weight, respectively.

These results may be considered a good indication with respect to the effective role of micro-elements on plant growth.

b. Juice quality:

Results given in Table (33) show that juice quality in terms of total soluble solids, sucrose and purity percentages were significantly affected by molybdenum fertilizer levels.

An examined view to the effect of molybdenum fertilizer on the juice quality measurements, it could be noted that those measurements responded to molybdenum element as similar as their responded to boron elements**.**

Increasing molybdenum fertilizer decreased the values of total soluble solids percentage. This finding was true in the two seasons and their combined.

On the contrary the response of sucrose and purity percentages to the additional increase of molybdenum was positive, applying 0.25 kg Mo/fed raised the values of sucrose percentage over that of control amounted by 5.82 %, 4.93 % and 5.37 %. Corresponding by 7.06 %, 6.71 % and 6.87 % for juice purity percentage in the two seasons and their combined respectively. Raising the applied dose of molybdenum to 0.50 kg Mo/fed attained additional increase over check treatment reached to 9.74 %, 8.53 % and 9.10 % for sucrose percentage corresponding to 13.81 %, 12.44 % and 13.12 % for purity percentage in the two growing seasons and their combined successively.

c. Chemical constituents:

Data presented in Table (34) reveal the influence of molybdenum fertilizer on the boron content in the different parts of sugar beet plants.

Results showed that boron contents in the various organs of sugar beet plants in terms of roots, petioles and blades were significantly increased as molybdenum fertilizer levels increased from zero to 0.50 kg Mo/fed. These results were true in the two seasons and their combined except the combined over the two seasons of the boron content in the petioles where the difference did not reach the level of significance. It is obvious that the application of 0.50 kg Mo/fed gave the highest value of boron contents in root, petiole and blade. These results are accepted since the applied molybdenum fertilizer levels increased its contents in the different plant organs.

This observation may be indicate to the relative important of molybdenum fertilizer application to sugar beet plants especially that this element appeared an effective role in juice quality Table (33).

Results in (Table, 36) reveal that the differences in nitrogen percentages in root, petiole and blade among the studied

molybdenum fertilizer levels were significant in the two seasons and their combined.

The results obtained throw some lights on the inverse relationship between molybdenum application and nitrogen contents in sugar beet plants. Based on the results obtained, increasing the applied dose of molybdenum decreased nitrogen percentage (Table, 36). This phenomenon is considered a good result because it well know that the highest, the nitrogen content in sugar beet roots and the lowest the juice quality.

Data in Table (37) indicate that potassium concentrations in root, petiole and blade were significantly influenced by the applied molybdenum fertilizer levels.

The results in Table (38) show that sodium concentration in root was significantly affected by molybdenum fertilizer levels without significant difference between zero and 0.25 kg Mo/fed. Meanwhile, the differences in sodium content in petiole were insignificant in the two growing seasons and their combined. However, the differences in this trait were significant in blade.

Results given in Tables (37 and 38) show that potassium and sodium percentages were significantly affected by the applied doses of molybdenum fertilizer. And regardless the significance, it could be noted that both of potassium and sodium contents in sugar beet roots had an inverse relationship with the applied dose of molybdenum, and in general increasing molybdenum application tended to lower the values of potassium and sodium percentages in petioles and leaf blade of sugar beet plants.

Once more, the irreversible effects of the applied doses of molybdenum fertilizer on the root content from nitrogen, potassium and sodium, may be considered very important results for sugar manufacture, because, it is will known that there is an inverse relationship between the concentration of such elements (impurities) and the extracted sugar. Based on these results, it could be recommended by molybdenum application to decrease the impurities (nitrogen, potassium and sodium) consequently increased sugar extraction.

d. Yield and its components:

Results given in Table (39) show the influence of molybdenum fertilizer on the root, sugar and top yields/fed.

Concerning the influence of molybdenum element on root fresh weight yield/fed. The available results in Table (39) elucidate that there was a positive response in the values of root yield to the applied levels of molybdenum fertilization. This finding was completely true in both seasons and their combined. However, it could be noted that both of molybdenum element levels surpassed check treatment statistically, meanwhile the difference between the examined levels of molybdenum i.e. 0.25 and 0.50 kg Mo/fed reach the level of significance in both seasons and their combined. Once more, the additional increase in the value of root yield as a result of applying 0.25 kg Mo/fed

amounted to 3.44 %, 2.23 % and 2.81 % in the first, second seasons and their combined respectively, corresponding 6.16 %, 5.57 % and 5.85 % when the level of molybdenum fertilizer was increased to 0.50 kg Mo/fed. These results are in the same trend with those found by **Nemeat-Alla (1997)**.

Data in Table (39) show a significant effect due to the used molybdenum fertilizer levels and that molybdenum fertilizer level of 0.50 kg Mo/fed gave the highest values of root yield followed by 0.25 kg Mo/fed, while zero gave the lowest one in the two seasons and their combined analysis. These results are in the same trend with those found by **Meirmanov** and **Nuralin (1977)** and **Nemeat (1997)**.

Combined analysis clarified that the addition of 0.50 kg Mo/fed gave 1.71 and 0.85 ton of roots/fed higher than that produced by zero and 0.25 kg Mo/fed, respectively. In addition, applying 0.50 kg Mo/fed gave the greatest top yield/fed and out-yielded zero and 0.25 kg Mo/fed by 2.62 and 1.29 ton/fed, respectively. Meantime, the same level gave the highest values of sugar yield/fed followed by 0.25 kg Mo/fed and the control.

As to the effect of molybdenum fertilizer levels on the sugar yield/fed, results obtain in Table (39) pointed out that sugar yield distinctly and positively responded to molybdenum fertilizer application. This response was fairly true and significantly in the two growing seasons and their combined. With respect to the additional benefit to molybdenum application, it could be noticed that the additional increment in sugar yield as a result to application of 0.25 kg Mo/fed reached 9.73 %, 7.15 % and 8.55 % for the first and second seasons and their combined respectively, corresponding to 16.81 %, 14.53 % and 15.78 % when the applied dose of molybdenum fertilizer was 0.50 kg Mo/fed. The relative effect of molybdenum element on sugar yield was recorded before by **Nemeat-Alla (1997)**.

Data collected in Table (39) reveal that yield of top fresh weight was significantly increased as the applied dose of molybdenum increased. Application of 0.50 kg Mo/fed recorded the highest significant value of top fresh weight yield. Both of the used level of molybdenum fertilizer i.e. 0.25 and/or 0.50 kg Mo/fed surpassed check treatment (unfertilized treatment) with respect to top fresh weight yield. This finding was true in the two seasons and their combined. The amount of increment in the value of top fresh weight yield of the combined over the two seasons amounted to 11.82 % and 23.30 % over control by increasing the supplied level of molybdenum to 0.25 and 0.50 kg Mo/fed, respectively. The effective role of molybdenum element in its effect on top fresh weight has been reported by **Nemeat-Alla (1997)**.

7. Effect of interaction between molybdenum fertilizer levels and seasons:

The effect of the interaction between molybdenum fertilizer levels and seasons are showed in (tables 32-39). The collected results cleared to insignificant effects on the most traits.

8. Effect of interaction between varieties and boron fertilizer levels:

The effect of interaction between varieties and boron levels had significant effects on boron concentration in blade (Table, 40), molybdenum concentrations in petiole (Table, 41), blade (Table, 42) and nitrogen concentrations in petiole (Table, 43) and blade (Table, 44).

The highest values of boron concentration in blade was obtained with 1.00 kg B/fed for sugar beet variety Gloria. On the other hand, the highest value of nitrogen concentration in blade was recorded by adding 1.00 kg B/fed with sugar beet variety Kawemira.

The highest values of molybdenum concentration in blade was recorded by applying 0.50 kg B/fed with the sugar beet variety Kawemira, but the highest values of molybdenum concentration in petiole was detected by control with sugar beet variety Kawemira.

Concerning the influence of the interaction between varieties and boron fertilizers on nitrogen concentration in petiole, variety Kawemira with 1.00 kg B/fed gave the lowest

percentage followed by Montebianco. Gloria variety gave the highest one. This finding was completely true in the combined.

The highest values of nitrogen percentage in blade was recorded by applying 1.00 kg B/fed with the sugar beet variety Montebianco. The lowest values of nitrogen percentage was detected by 0.50 kg B/fed with sugar beet variety Kawemira in the combined.

9. Effect of interaction between varieties, boron fertilizer levels and seasons:

With the exception of boron, molybdenum concentrations in blade and nitrogen percentage in petiole, the other traits showed significant differences due to the effect of interaction between varieties, boron levels and seasons (Tables, 40 - 44). This result may be due to the fluctuated effect of the interaction of varieties and boron levels from season to season.

10. Effect of interaction between varieties and molybdenum fertilizer levels:

Results indicate that the effect of interaction between molybdenum fertilizer levels and varieties in the combined over the two seasons revealed a significant effect on root length (Table, 45), total soluble solids percentage (Table, 46) and

potassium and sodium percentages (Tables, 47 and 48) in sugar beet roots. The highest value of root length was found by application 0.50 kg Mo/fed with the sugar beet variety Montebianco. The lowest values of total soluble solids percentage and potassium percentage were clarified by adding 0.50 kg Mo/fed with sugar beet variety Gloria in the combined over the two seasons. Meantime, the same variety recorded the lowest value for sodium percentage in root by control.

11. Effect of interaction between varieties and molybdenum fertilizer levels and seasons:

The effect of interaction was insignificant on total soluble solids, potassium, sodium percentages in blade and root length (Tables, 45 - 48).

12. Effect of interaction between boron and molybdenum fertilizers:

The results in Table (49) reveal that total soluble solids percentage recorded the lowest percentage by fertilizers mix (0.50 kg B/fed + 0.50 kg Mo/fed). This response was fairly true and significantly compared the control in the second growing season and the combined over the two seasons.

The results in Table (50) indicate that sodium percentage in blade was significantly influenced by the applied boron and molybdenum fertilizer levels. The lowest percentage gave by

applied 0.50 kg B/fed with 0.50 kg Mo/fed in the combined as well as in the first season, but it gave the highest percentage by unfertilized.

13. Effect of interaction between boron and molybdenum fertilizers and seasons:

The effect of this interaction showed insignificant effects on total soluble solids % and sodium percentage in blade (Tables, 49 and 50).

14. Effect of interaction between varieties, boron and molybdenum:

The results presented in Table (51) show the influence of the interaction between boron and molybdenum fertilizers on the total soluble solids percentage of some sugar beet varieties.

Results given revealed that the values of total soluble solids percentage was statistically affected by the second order interaction i.e. between boron, molybdenum fertilizers and sugar beet varieties. However, it could be noted that increasing the applied levels for any of the two micro-elements i.e. boron and/or molybdenum decreased the values of total soluble solids percentage. These finding were completely true under the different sugar beet varieties in this study. The highest values of total soluble solids percentage were recorded for the unfertilized treatment.

15. Effect of interaction between varieties, boron, molybdenum and seasons:

The interaction revealed insignificant effects on total soluble solids percentage (Tables, 51).