SUGAR BEET TYPES AND SOME MICRO-ELEMENTS IN RELATION TO YIELD AND QUALITY

By
BASEM SOBHY IBRAHIM

A thesis submitted in partial fulfillment
of
the requirements for the degree of

MASTER OF SCIENCE

in
Agricultural Science
(Agronomy)

Department of
Agronomy and Agricultural Mechanization
Faculty of Agriculture,
Benha University

2006

SUGAR BEET TYPES AND SOME MICRO-ELEMENTS IN RELATION TO YIELD AND QUALITY

By
BASEM SOBHY IBRAHIM
B. Sc. Co-oper. and Agric., Sci.,
High Institute of Agricultural Co-operation, (1992)
Complimentary Studies of Agronomy Science,
Faculty of Agriculture, Benha University, (2002)

Under the supervision of:

1- Prof. Dr. Ali Abd-EL Maksoud EL-Hosary A.A. El-Hosary
Prof. of Agron. and Vice Dean for Student Affairs and Education Fac. of Agric., Benha Univ.

2- Prof. Dr. Adly Mohamed Morsy Saad ....
Prof. of Agron., Fac. of Agric., Benha Univ.

3- Prof. Dr. Ibrahim Hanafy EL-Geddawy ....
Prof. of Agron., and Vice Director of Sugar Crops Research Institute, Agricultural Research Center (ARC).

2006

Approval Sheet

SUGAR BEET TYPES AND SOME MICRO-ELEMENTS IN RELATION TO YIELD AND QUALITY

By
BASEM SOBHY IBRAHIM
B. Sc. Co-oper. and Agric., Sci.,
High Institute of Agricultural Co-operation, (1992).
Complimentary Studies of Agronomy Science,
Faculty of Agriculture, Benha University, (2002).

This thesis for M. Sc. degree has been Approved by:

1- Prof. Dr. Olfat H. El- Bagoury ....
Prof. Emeritus of Agron., Dep. of Agron., Faculty of Agric., Ain Shams Univ.

2- Prof. Dr. Ali Abd-EL Maksoud EL-Hosary ....
Prof. of Agron., and Vice Dean for Student Affairs and Education Fac. of Agric., Benha Univ.

3-Prof. Dr. Gamal M. Shams El- Din ....
Prof. of Agron., Fac. of Agric., Benha Univ.

4- Prof. Dr. Adly Mohamed Morsy Saad ....
Prof. of Agron., Fac. of Agric., Benha Univ.

5- Prof. Dr. Ibrahim Hanafy EL-Geddawy ....
Prof. of Agron., and Vice Director ~~of Sugar~~ Crops Research Institute, Agricultural Research Center (ARC).

Date of Examination: / /

ACKNOWLEDGEMENT

First of all, prayerful thanks to ***ALLAH*** for helping me to finish this thesis.

The author wishes to express his deep appreciation and gratitude to the senior advisor ***Prof. Dr. A. A. EL-Hosary***, Prof. of Agronomy, Faculty of Agriculture, Benha University, for his keen supervision and valuable help which he gave during the course of this investigation and constructive criticism during the preparation of this manuscript.

Sincere thanks are due to ***Prof. Dr. A. M. M. Saad***, Prof. of Agronomy, Faculty of Agriculture, Benha University, for his supervision, guidance, help and encouragement throughout the work of the presented thesis.

Deep gratitude is due to ***Prof. Dr. I. H. EL-Geddawy***, Head Research and Vice Director of Sugar Crops Res. Inst., ARC for his supervision, valuable assistance, guidance and constructive comments during the course of this work.

Sincere thanks are due to ***Prof. Dr. Abd- Elwahab I. Allam***, Head of Research Emeritus, Sugar Crops Res. Inst., ARC and Vice Director of Sugar Crops Council and ***Prof. Dr. A. M. Abu Dooh***, Head of Research and Director of Sugar Crops Res. Inst., ARC for their valuable guidance and precious advice and help during the progress of this work and the preparation of the manuscript.

Thanks are due to all staff members of Sugar Crop Research Institute, Sakha and Giza for their help.

At last but not least my heart thanks are due to ***my mother*** for every thing in my life, also my brother, sisters, wife and my sweetness daughter *"Malak"*.

CONTENTS

INTRODUCTION

INTRODUCTION

Sugar beet *(Beta vulagaris* L.) is the second important sugar crop in Egypt after sugar cane. The importance of this crop comes from not only its ability to grow in the newly reclaimed lands, but also from giving high sugar recovery as well as its lower water requirement.

In Egypt the gap in sugar production amounted to 803.000 tons* of sugar per year imported from abroad. To attempt to minimize the gap between production and consumption, many efforts have been done to increase yield of sugar beet horizontally and vertically and sugar cane vertically.

Nowadays, there are three sugar beet factories; the first was established in Kafr El-Sheikh Governorate, the second in Dakahliya Governorate and the third factory was allocated in Fayoum Governorate

Varieties are ones of the most important factors directly affected in the production of sugar beet root yield.

The low availability of microelements resources represented the main problem affecting agricultural development in the arid and semi-arid regions. The proper application of the different microelements resources is needed.

***Sugar Crops Council, Ministry of Agriculture, Giza, Egypt, 2005.**

Application of microelements for nutrients mostly depends on their effect on crops.

Soils of the Nile Valley and the newly reclaimed areas are in particular suffered from the lack of micro nutrients after Aswan High Dam construction.

The present work was conducted to find out the relative importance of two micro-elements (Boron and Molybdenum) to some sugar beet varieties in relation to yield and quality attributes.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The present literature will be arranged under two main parts as follows:

1- Varietal performance.
2- Effect of micro-elements.

1. VARIETAL PERFORMANCE ON:

a. Growth criteria:

Milford and Riley (1980) studied some growth traits of six monogerm and three multigerm sugar beet varieties. They found differences between varieties in root weight per plant. These differences were caused more by differences in rates of expansion and final sizes of individual leaves than by differences in rates of leaf production. When the growth of the first six leaves of each plant was examined in details, the greater size of successive leaves and genotypic differences between comparable leaves were more attributable to differences in leaf expansion rate than to differences in the duration of leaf expansion.

AL-Saad, *et al.* (1984) evaluated 4 sugar beet cultivars; Maribo Marina-Poly, Maribo Maroc-Poly, Maribo Magna-Poly and Maribo Auta-Poly. They found that the mean weight of leaves did not differ significantly between cultivars. They added that the mean root weight assessed at harvest did not differ significantly between cultivars.

Badawi (1985) evaluated four sugar beet varieties; Tribel, Maribo, Marcopoly, and Trirave. Trirave variety gave the highest values for all characters studied except root length.

Hanna, *et al.* (1988) evaluated three sugar beet varieties viz, Maribo, Marcopoly and Trirave. They pointed out that Trirave surpassed the other varieties in root fresh weight and root diameter.

Ghura (1989) showed that the studied sugar beet varieties significantly differed in leaf weight.

Abd El-Aal and Dawwam (1991) tested fifteen imported varieties of sugar beet at Minufiya governorate, Egypt. They detected that the studied varieties significantly differed in their growth. The variety Irinova exceeded the other varieties in root diameter, root weight, while Curave variety was superior in top weight per plant. The highest values of root length were obtained from Z R 5342 and Delamon varieties, respectively.

Abd Alla (1992) evaluated three sugar beet varieties under Sadat city region, and found that the differences among sugar beet varieties were significant for root growth characters, i.e. root weight per plant, root length and diameter. Cerespoly-3 variety surpassed both Maghribel and Curave varieties for all characters in both seasons. He added that the highest values of foliage weight per plant and leaves number were obtained from Maghribel and Curave, respectively.

Nassar (1992) evaluated eleven multigerm varieties namely Kawemira, Ras poly, Pleno, Maribo Maroc Poly, Ceres Poly-3, Tribel, Supra Poly, Maghribel, KWS-695, Kaweterma and Desperiz Poly-N. He showed that Supra Poly variety was superior in root size (in terms of length, diameter and fresh root weight) followed by Maghribel. Also, he found that varieties differed significantly in growth traits. However, the highest root dry matter percentages resulted from Cerespoly-3, Maghribel and Pleno, respectively.

Abo El-Ghait (1993) found that sugar beet varieties were significantly different in root length and diameter.

Mokadem (1993) studied seven sugar beet cultivars for some charactersics. Pleno followed by Fakir produced the highest values overall growth.

Besheit, *et al.* (1994) reported that the average root weight of Maribo cultivars was heavier than that of sers polyone.

Saita, *et al.* (1994) evaluated sugar beet varieties E, N, and Z types for root and top weight on eight sampling dates over a 5-month period. They found that the root weight of E-type showed more rapid increase throughout the growing period particularly in the early stages than the other varieties and maintained greater root weight to the end of the growth. Root weight of Z-type showed a slow increase during the growing period especially in the later stages. The rate of increase in top weight in the later growing period was high in Z-type while it was low in E-type variety. The time of maximum top growth followed by a declining growth was reached in variety E-type earlier than in Z-type variety. The three varieties showed the same crop production.

Shalaby (1998) showed that the tested sugar beet varieties differed significantly in root diameter, root fresh weight and root/top ratrio. He found that Pamela variety surpassed Univers variety in root diameter and root fresh weight, while Univers varierty surpassed Pamela variety in top fresh weight and root/top ratio.

El-Taweel (1999) found that sugar beet varieties Top, Kawemira and Pleno did not differ significantly in dry weight of leaves, roots and total dry weight/plant. The variety Pleno was the highest one in this respect followed by Kawemira and Top in a descending order.

Mahmoud, *et al.* (1999) evaluated five sugar beet varieties namely Maghribel, Zwaan poly, KWS/695, Pleno and Tribel. They found that Maghribel and Zwaan poly had the highest root weight and dry matter accumulation throughout the growing season.

Ramadan (1999) recorded significant differences among sugar beet varieties. Variety Ras poly gave the highest individual root weight.

Ramadan and Hassanin (1999) tested six sugar beet varieties; Sofi, Maghribel, Desperiz poly-N, Marathon, Pamela and Eva. They found that the heaviest roots (714 and 729 g) were obtained from Pamela variety in the first and second seasons, respectively compared with the other varieties.

Abd EL-Fatah (2000) studied the performance of six sugar beet varieties (Alex, Universe, Kawemire, Pleno, Panther and Toro). He found that varieties differed significantly in plant dry weight. Variety Panther had almost the best growth traits as well as the highest individual root weight.

Al-Labbody (2003) found significant differences among ten multigerm varietries (Toro, Lados, Vital, Gloria, Pamela, Del 937, Del 938, Del 939, kawemira and Athos poly) and five monogerm varieties (Marathon, Rhopsodie, Tellus, Vital and Helis), sugar beet varieties, root traits (root length, root diameter and root fresh weight), top dry weight and root/top ratio.

Osman, *et al.* (2003) studied the performance of three sugar beet varieties (Gloria, Toro, Pamela). They found that Gloria variety had the highest values of total dry weight of leaves compared with the other varieties, whereas but Toro variety had the highest values of root length.

Shalaby (2003) studied the performance of six sugar beet varieties (Del 936, 937, 938 and 939, Desperespoly and Demapoly). Demapoly variety surpassed the other varieties in root length, root diameter, root and top fresh weight.

Ali (2005) studied the performance of three sugar beet varieties (KWS-9422, Pamela, Recolta-poly). Pamela variety had the highest values of root length, root diameter, root and top fresh weight/plant compared with the other varieties.

b. Juice quality and chemical constituents:

Abd El- Ghaffar, *et al.* (1981) found that the sugar beet varieties (Trirave, Polyrave, Pedigree) did not show any remarkable differences in the sugar content.

Campbell and Kern (1982) in USA, evaluated ten sugar beet varieties at five locations during four years. They found that most cultivars were not significantly different from each other for recoverable sucrose/ha, the influences of sucrose percent and impurities were apparent.

Jassem (1982) reported that the monogerm varieties had a lower sugar content than multigerm varieties.

Sako, *et al.* (1982) evaluated four varieties in two localities differing in soil type. The percentages of K, Na, and α-amino nitrogen and the sugar percentage in the molasses were least in the variety Monofort.

AL-Saad, *et al.* (1984) evaluated four sugar beet cultivars; Maribo Marina-Poly, Maribo Maroc-Poly, Maribo Magna-Poly and Maribo Auta-Poly. They found that the mean total soluble solids was reducing while sugars non-reducing sugars and total sugar contents assessed at harvest did not differ significantly between cultivars.

Badawi (1985) examined four sugar beet varieties; Tribel, Maribo, Marcopoly, and Trirave. The first three tested varieties were significantly differed in sucrose percentage. Trirave variety gave the highest values for all characters studied except sucrose percentage.

Kimber and Mc Cullagh (1986) tested 16 sugar beet varieties, they found that the mean root yield was 55.56 ton/ha. They showed that the recorded sugar content values of the tested sugar beet varieties were Solohill (17.67%), Hilma (17.59%), Bella (17.57%), Ouatio (17.50%) and Samson (17.28%).

Tripathim *et al.* (1986) reported that the examined sugar beet varieties significantly differed in sugar content. These variations ranged from 13 to 18 in sucrose percentage.

Cermin and Michalikova (1988) in trials included 12 local and foreign varieties during 3 years. They found that the highest sugar content resulted from Kaweduca, Kawemaja, Scaldia and Morinda cultivars.

Kupper and Herzog (1988) compared two varieties combining high sugar content (N type) and one high sugar content (Z type). A triploid Z type had a higher sucrose content (17.2 %) than the other varieties 16.2-16.8%.

Obead (1988) tested five multigerm varieties viz, Kawemira, Kawpoly, Kawepure, Kaweterma, and Trible and two monogerm ones viz, Kawemono and Kawegigamono. He added that the differences among varieties in sucrose and purity percentages were not significant.

Ghura, Nabawia (1989) showed that studied sugar beet varieties significantly differed in TSS% of sugar beet.

Abd El-Aal and Dawwam (1991) tested fifteen imported varieties of sugar beet at Minufiya governorate, Egypt. They detected that the studied varieties significantly differed in their quality traits. The higher values of sugar percentage were obtained from Z R 5342 and Delamon varieties, respectively.

Besheit, *et al.* (1991) showed that Tribel cultivars recorded superiority in term of quality as compared with Maribo marcopoly.

Hassanin (1991) compared two sugar beet varieties, i.e. Recoltapoly and Trirave and two harvesting dates, i.e.180 and 195 days after sowing under Egyptian conditions. He found that no significant differences were detected between varieties in both sucrose and purity percentage.

Abd Alla (1992) evaluated three sugar beet varieties under Sadat city region. The differences between varieties were significant for TSS and juice purity percentages, but they were insignificant for sucrose percentage.

Nassar (1992) evaluated eleven multigerm varieties namely Kawemira, Ras poly, Pleno, Maribo Maroc Poly, Ceres Poly-3, Tribel, Supra Poly, Maghribel, KWS-695, Kaweterma and Desperiz Poly-N. He found that varieties exhibited significant differences in quality traits. He showed that Supra Poly variety was superior in purity percentage, sugar recovery % followed by Maghribel. He added that sucrose percentage ranged from 16.19 to 17.95 % in the 1st season and from 16.16 to 19.07 % in 2nd season for Supra Poly and Tribel, respectively while the highest percentage of impurity components expressed as Na, K and α-amino -N resulted from the Maribo Maroc Poly variety. The highest number of harvested roots resulted from Tribel.

Abo El-Ghait (1993) found that sugar beet varieties were significantly differed in TSS % and sucrose percentage.

Mokadem (1993) compared seven sugar beet cultivars for some characteristics. Pleno followed by Fakir produced the highest values overall juice quality.

Besheit, *et al.* (1994) reported that variety Serspoly gave higher TSS% and sucrose cotent than that of Maribo cultivars.

Sperlingsson and Larsson (1997) tested 17 sugar beet varieties from Sweden, Denmark, Netherlands and Belgium in 5 trials in Sweden. The results showed that the best five varieties were; Hana, KWS/6227, HM/1457, St 160 and HM/1458, a sugar content was the highest in KWS/6227 that was 18.06 %.

Shalaby (1998) showed that the tested sugar beet varieties differed significantly in sucrose percentage and TSS %. He found that Univers variety surpassed Pamela variety in sucrose and TSS percentages.

El- Taweel, Fayza (1999) in Egypt, found that sugar beet varieties Top, Kawemira and Pleno did not differ significantly in sucrose, TSS, purity, Na and K%. Her results showed significant differences among varieties in α-amino -N content in roots. The variety Pleno was the highest one in this respect followed by Kawemira and Top in a descending order.

Mahmoud, *et al.* (1999) in Egypt, evaluated five sugar beet varieties namely Maghribel, Zwaan poly, KWS/695, Pleno and Tribel. They found that Maghribel and Zwaan poly had the highest sucrose% ranged from 18.13 to 17.05% for Zwaan poly and Tribel in the 1st season and from 17.98 to 17.2% for Maghribel and Pleno in the 2nd one, respectively. They added that the variety Tribel gave the highest impurities in beet roots. The lowest% of Na resulted from KWS-695, while the lowest% of K and α-amino-N resulted from Zwaan poly. The variety Maghrbel gave the highest recoverable sugar %.

Ramadan (1999) recorded significant differences among sugar beet varieties, (Pleno, Eva and Ras poly) in juice quality. The variety Ras poly gave the highest impurities in roots. The variety Eva had the best quality traits in terms of the highest sucrose and purity% as well as the lowest% of sucrose loss to molasses.

Ramadan and Hassanin (1999) tested six sugar beet varieties; Sofi, Maghribel, Desperiz poly-N, Marathon, Pamela and Eva. The highest sucrose and purity% were obtained from Desperiz poly-N variety. Desperiz poly-N variety gave the highest recoverable sugar%, sucrose loss to molasses at harvest, but the highest % of impurities in terms of Na, K and amino-N were obtained from Marathon and Pamela varieties.

Abd EL-Fatah (2000) studied the performance of six sugar beet (Alex, Universe, Kawemire, Pleno, Panther and Toro) under two harvesting dates (180 and 200 days after sowing). Panther variety recorded the highest contents of impurities (α-amino -N, K, and Na). The variety Kawemira had the highest percentage of recoverable sugar.

Kajiyama, *et al.* (2000) claimed that root sugar concentrations were higher in Monoesu S. than in Megumi.

El-Geddawy, *et al.* (2001) pointed out that sugar beet variety Lola attained the superiority over the other three studied varieties with respect to TSS%. However, this effect was insignificant with respect to sucrose percentage.

Havashida, *et al.* (2001) demonstrated that sugar beet variety Abend is higher in sugar content and a little lower in Harmful non–sugar than Humming.

Al-Labbody (2003) found significant differences among ten multigerm varietries (Toro, Lados, Vital, Gloria, Pamela, Del 937, Del 938, Del 939, kawemira and Athos poly) and five monogerm varieties (Marathon, Rhopsodie, Tellus, Vital and Helis) with respect to sucrose and purity% while TSS insignificantly differed in this respect.

Osman, *et al.* (2003) studied the performance of three sugar beet varieties (Gloria, Toro and Pamela). They found that variety Toro had the highest values of T.S.S%.

Shalaby (2003) studied the performance of six sugar beet varieties (Del 936, 937, 938, 939, Desperespoly and Demapoly). Del 938 surpassed the other varieties in TSS, Sucrose and Purity % and K% in sugar beet roots. Also, variety 939 surpassed the other varieties in α N and Na% in sugar beet roots.

Ali (2005) studied the performance of three sugar beet varieties (KWS-9422, Pamela, Recolta-poly). KWS-9422 variety had the highest values of total soluble solids percentage, whereas the variety Pamela had the highest values of sucrose and purity percentages.

c. Yield and its components:

Abd El- Ghaffar, *et al.* (1981) found that the sugar beet varieties (Trirave, Polyrave and Pedigree) increased significantly on the yield of A.J.I. in the first year and others are no significant differences in the yield of the varieties in the other two years.

Campbell and Kern (1982) evaluated ten sugar beet varieties at five locations during four years. They found that higher root yield was associated with lower sucrose concentration. They reported that most of the cultivars were not significantly different from each other for recoverable sucrose/ha.

Jassem (1982) in Poland, stated that the monogerm varieties are higher yielding than multigerm varieties.

AL-Saad, *et al.* (1984) evaluated 4 sugar beet cultivars; Maribo Marina-Poly, Maribo Maroc-Poly, Maribo Magna-Poly and Maribo Auta-Poly. They found that the root yields and number of plants/ha did not differ significantly between cultivars.

Taha, *et al.* (1985) studied three sugar beet varieties; Maribo, Marcopoly and Trible Trirave. Trirave significantly outyielded the other two varieties in root and top yield per feddan.

Kimber and McCullagh (1986) tested 16 sugar beet varieties, they found that the mean root yield was 55.56 ton/ha. The sugar beet varieties Amethyst, Julia, Primo, Regina, Bingo, Bravo, and Promo showed better sugar yield than the average of (17.2 %).

Tripathi, *et al.* (1986) reported that the examined sugar beet varieties significantly differed in root yield/ha. These variations ranged from 39 to 70 tons of roots/ha.

Attia and Sultan (1987) reported the variety Tribel was superior in root yield ton/fed (32.49 and 29.13 in both seasons), biological yield ton/fed (57.73 and 51.63 in both seasons) and sugar yield ton/fed (4.59 and 4.28 in both seasons) and followed by Kawegigamono and then Mono svalove.

Cermin and Michalikova (1988) showed that, trials included 12 local and foreign varieties during 3 years. They found that the highest yielding varieties were obtained from Kawerenta and Apache which exceeded the standard variety (Dobrovicka-A) in root yield by 5.03 and 4.81 ton/ha, respectively, while sugar yields were highest in Kawerenta, Marinda and Betimo which exceeded the standard by 0.95, 0.64 and 0.62 ton/ha, respectively.

Hanna, *et al.* (1988) evaluated three sugar beet varieties viz, Maribo, Marcopoly and Trirave. They pointed out that Trirave surpassed the other varieties in yields of sugar and tops/fed.

Kupper and Herzog (1988) compared two high yielding varieties (E type); two varieties combining high root yield. They found that the diploid E type had a refined sugar yield of 7.75 ton/ha compared with 7.25 and 7.60 tons/ha for the other types.

Obead (1988) tested five multigerm varieties viz, Kawemira, Kawpoly, Kawepure, Kaweterma, and Trible and two monogerm ones viz, Kawemono and Kawegigamono. He found that Trible and Kawegigamono produced the highest yields of roots, tops and sugar/fed.

Ghura (1989) showed that the studied sugar beet varieties significantly differed in root yield of sugar beet.

Abd El-Aal and Dawwam (1991) tested fifteen imported varieties of sugar beet. They detected that the studied varieties significantly differed in their yield traits. The variety Irinova exceeded the other varieties in root yield/fed. Moreover, the variety KWS was superiors in root yield.

Hassanin (1991) compared two sugar beet varieties, i.e. Recoltapoly and trirave and two harvesting dates, i.e.180 and 195 days after sowing under Egyptian conditions. He found that Trirave variety produced heavier root and outyielded Recoltapoly in root and sugar yields per feddan.

Abd Alla (1992) evaluated three sugar beet varieties. He found that average yields of top, root, and sugar were 5.972, 38.046 and 5.76 tons/fed, respectively.

Leilah and Nasr (1992) showed that the sugar beet cultivars markedly differd in their potential yield. Tribel cultivar recorded the highest root and sugar yield/fed, as compared to Maribo marcopoly or Trirava.

Nassar (1992) evaluated eleven multigerm varieties namely Kawemira, Ras poly, Pleno, Maribo Maroc Poly, Ceres Poly-3, Tribel, Supra Poly, Maghribel, KWS-695, Kaweterma and Desperiz Poly-N. He found that varieties exhibited significant differences in yield traits. He showed that Supra Poly variety was superior in root, sugar and top yields/fed followed by Maghribel. The highest number of harvested roots resulted from Tribel.

Abo El-Ghait (1993) found that sugar beet varieties were significantly different in top, root and sugar yields/fed.

Mokadem (1993) compared seven sugar beet cultivars for some characteristics. Pleno followed by Fakir produced the highest values overall yield.

Besheit, *et al.* (1994) reported that the average of Maribo cultivars was heavier than that of Serspolyone. This was reflected in total root yield/fed.

Domska (1996) found that sugar beet cv. AJ Poly and PN Mono-1 were gave the highest root, top and sugar yield.

Schwarzbach, *et al.* (1996) summarized the results of joint field trials with 39 sugar beet varieties. They noticed that all of them gave sugar yields of at least 10 ton/ha. Some could be classified as high yielding sugar types, e.g. Adonis, Ibis and Reka, while others were normal or normal/high-yielding types, e.g. Oryx, Stella, Magnat and Matader.

Sperlingsson and Larsson (1997) tested 17 sugar beet varieties from Sweden, Denmark, Netherlands and Belgium in five trials in Sweden. The results showed that the best five varieties were; Hana, KWS/6227, HM/1457, St 160 and HM/1458. Root yield was the highest in KWS/6227 (49.9t/ha).

Shalaby (1998) showed that the tested sugar beet varieties differed significantly in root yield and number of roots/fed. He found that Pamela variety surpassed Universe variety in root yield and number of roots/fed.

El-Taweel (1999) found that sugar beet varieties Top, Kawemira and Pleno did not differ significantly in top and sugar yields/fed. The variety Pleno was the highest one in this respect followed by Kawemira and Top in a descending order.

Mahmoud, *et al.* (1999) evaluated five sugar beet varieties namely Maghribel, Zwaan poly, KWS/695, Pleno and Tribel. They found that Maghribel and Zwaan poly had the highest top yield/fed. The variety Maghrbel gave the highest root and sugar yields/fed.

Ramadan (1999) recorded significant differences among sugar beet varieties, (Pleno, Eva and Ras poly) in yield. The variety Ras poly gave the highest number of harvested roots, the highest individual outyielded the other varieties in root and recoverable sugar yield/fed.

Ramadan and Hassanin (1999) tested six sugar beet varieties; Sofi, Maghribel, Desperiz poly-N, Marathon, Pamela and Eva. Desperiz poly-N variety gave the highest number of roots/fed at harvest. They added that the variety Marathon gave the highest root yield (27.2 and 27.7 ton/fed) and recoverable sugar yield (4.13 and 4.21 ton/fed) in the 1^{st} and 2^{nd} season, respectively.

Abd EL-Fatah (2000) studied the performance of six sugar beet (Alex, Universe, Kawemire, Pleno, Panther and Toro) under two harvesting dates (180 and 200 days after sowing). The variety Panther had almost the best root yield and recoverable sugar yield compared with the other varieties. The variety Kawemira had the highest top yield/fed.

Bogdevich, *et al.* (2000) revealed that root yield of sugar beet cv. Belorusskaya 69 was about 40 ton/ha, with sugar yields of 6.73 ton/ha.

Kajiyama, *et al.* (2000) claimed that root yields of Megumi were 61.3-76.6 ton/ha compared with 57.3-75.7 ton/ha in Monohomari and 54.3-71.7 t in Monoesu S. Sugar yields were higher in Megumi than in monohomari.

El-Geddawy, *et al.* (2001) pointed out that sugar beet variety Lola attained superiority over the other three studied varieties with respect to root and sugar yields.

Havashida, *et al.* (2001) demonstrated that sugar beet variety Abend is higher in root yield.

Al-Labbody (2003) found significant differences among ten multigerm varietries (Toro, Lados, Vital, Gloria, Pamela, Del 937, Del 938, Del 939, kawemira and Athos poly) and five monogerm varieties (Marathon, Rhopsodie, Tellus, Vital and Helis), sugar beet varieties top, root, and sugar yields.

Ali (2005) studied the performance of three sugar beet varieties (KWS-9422, Pamela, Recolta-poly). Pamela variety had the highest values of root, top and sugar yields but the variety KWS-9422 gave the lowest ones.

2. EFFECT OF MICROELEMENTS ON:

a. Growth criteria:

Chelombitko (1970) found that foliar nutrition of 0.01 % boric acid applied to sugar beet at the 5 to 8 leaf stage increased chlorophyll content and photosynthetic in the leaves.

Hanousek (1973) investigated the effect of compound application of trace elements fertilizer containing 6.37% of boron at the rates of 0.30, 4.80 or 6.60 kg/ha to sugar beet plants. He found that application of 0.3, 4.8 up to 6.6 kg/ha decreased forking of the roots.

Omelchenko, *et al.* (1973) found that the treatment seeds of sugar beet with B and Mo increased chlorophyll contents and photosynthesis.

Anikeev, *et al.* (1978) observed that treatment seed of sugar beet with B decreased water deficit, increased photosynthesis, prevented the secondary regrowth of leaves.

Ewida, *et al.* (1984) showed that spraying B at rate of 100 ppm to sugar beet plants gave the greatest dry weight of both roots and leaves at harvest time.

Gritsenko *et al.* (1985) proved that soaking sugar beet seeds in 0.02 % boric acid solution gave a higher germination rate% and increased growth.

Morsy and Taha (1986) found that the addition of B to sugar beet increased dry matter content in tops and roots of sugar beet plants.

Shahin (1986) reported that application of B at the rate of 50 ppm at 80 days from sowing gave the highest fresh and dry weight of root, leaf blade, root length and root width.

El-Mashhadi (1988) treated sugar beet plants with B at a rates of 1 and 2 kg/fed, he found that the application of 1 kg B/fed produced the highest fresh weight of roots as compared with the other treatments.

Moustafa (1989) found that soaking sugar beet seeds in B individually increased fresh and dry weight of leaves and roots.

Shaker and Al-Roami (1989) soaked sugar beet seeds in 0.05, 0.1 and 0.15% boric acid solution. All treatments were significantly affected leaf area, root number and plant dry matter. They added that soaking in 0.05 % boric acid gave high leaf area, total number of leaves, weight of roots and leaves.

Saif (1991) found that soil application of 0.5 Kg B/fed gave the highest value of tops criteria, i.e. leaves number, top fresh and dry weight per plants as well as top dry matter, fresh and dry weight of roots, root dry matter and root size of sugar beet length and diameter.

Mohamed (1993) found that the highest fresh weight of roots was produced from seeds soaked in 40 ppm solution of B solution for 24 hours before sowing.

Tariq, *et al.* (1993) reported that B application at 1, 2, 3 and 4 kg/ha significantly increased root diameter and length.

Wang (1994) found that B fertilizers applied as top dressing increased germination rate of monogerm seeds by

10.4%. Multigerm plants had higher leaf area compared with monogerm plants. The low germination rate of monogerm compared with Multigerm plants was attributed to short leaf rosette form.

Bondok (1996) found that foliar application of boron slightly increased root length and root fresh weight of sugar beet.

Nemeat Alla (1997) found that foliar spray with 1 g boric acid and 1 g molybdate ammonium solutions alone or combinations. Combinations between two microelements surpassed in root length, root diameter, dry weight of plants and higher growth rate compared with untreated plants.

Osman (1997) found that soil application with zero, 0.50 and 1.00 kg B/fed as a sodium borate 11 % B and a mixtures (B + Mn) 0.5 + 0.02 kg/fed and 1 + 0.04 kg/fed as soil application to fully expanded insignificantly increased LAI, root length, root diameter and root fresh weight.

Ibrahim (1998) studied the response of sugar beet to foliar spraying with B. He found significant differences in dry matter accumulation, root length, root diameter, crop growth rate and net assimilation rate due to microelements in favour of spraying with microelements mixture.

Jaszczolt (1998) found that dry matter in the roots was more affected when B applied during the period of rapid growth rather than at sowing.

Osman, *et al.* (2003) found that increasing the level of boron up to 2 kg B/fed increased leaf area, leaf area index, total dry weight, assimilation rate, root/top ratio and root length.

Enan (2004) found that soil application 0.5 kg B/fed increased root fresh weight/plant and 0.5 kg B/fed as well as mixture 0.5 kg B/fed + 4 kg Zn/fed increased root fresh weight/plant, leaves fresh weight/plant and 0.5 kg B/fed + 4 kg Zn/fed increased root length and diameter.

Nafei (2004) indicated that root length (in the 2[nd] season only) was significantly increased as boron level was increased from zero to 0.50 kg boron sulfate/fed, However, root fresh weight was significantly influenced by B rates added to sugar beet plants in both seasons.

Osman, *et al.* (2004) illustrated that increasing the level of B increased significantly total dry weight in both seasons. However, in the 2[nd] season increased significantly leaf area index, leaf area, root length and root fresh weight.

b. Juice quality and chemical constituents:

Chelombitko (1970) found that foliar nutrition of 0.01% boric acid applied to sugar beet at the 5 to 8 leaf stage increased the enzyme activities in the leaves, translocation of sugar to root and sugar content in the root.

El-Kobbia, *et al.* (1971) noticed that application of B either in soil in form of borax at a rate of 560 g/ha increased sucrose by 2.3-2.9%.

Brysov (1974) pointed out that spraying of 0.1 salt solution of Mo microelement increased root sugar content by 0.1-0.5%.

Vlasyuk, *et al.* (1974) reported that sugar beet given B and Mo increased root sugar content by 0.2- 0.7%.

Bedrinets, *et al.* (1975) reported that the application of super phosphate enriched with Mo and B showed increased root sugar contents by 0.1-0.5% from 21.5% on plots given super phosphate containing no trace elements.

Karvatskii (1975) found that application of super phosphate enriched with B and Mo increased root sugar contents by 0.3-0.6%.

Omelchenko (1975) found that the treatment of sugar beet seeds with B and Mo increased chlorophyll contents, photosynthesis, carbohydrate and energy metabolism.

Mazepin and Nikitaeva (1977) showed that treatment of sugar beet seed with 0.5 B kg/t seed increased the root sugar contents.

Tadorcic and Faller (1977) proved that with B application, there was a slight increase in the sugar content of sugar beet plants.

Anikeev, *et al.* (1978) observed that treatment seed of sugar beet with B decreased water deficit, increased sugar accumulation. B decreased the root ash and noxios N contents and molasses % during sugar production.

Sroller (1978) demonstrated that application of 0.6 kg B/ha increased the root content of TSS and sucrose%.

Krunic, *et al* (1980) showed that foliar spray of B in rate of 1-3 kg B increased root sugar content by 0.6-0.9% in all the different soil types.

Kalimeri and Pellumbi (1982) found that the application of B to sugar beet roots on brown clay soil increased sugar content from 0.5 to 1.4%.

Kudryashov (1985) cleared that soil and foliar application of B to sugar beet crops grown with B deficient soil increased root quality.

Gritsenko, *et al.* (1985) proved that soaking sugar beet seeds in 0.02% boric acid solution gave a higher germination rate and increased growth.

Morsy and Taha (1986) found that the used application of microelements three times ranged from 0.50 to 0.70% boric acid attained the best results of TSS % in roots.

Shahin (1986) reported that application of B at the rate of 50 ppm at 80 days from sowing gave the highest fresh and dry weight of root, leaf blade, root length and root width.

Dragan, *et al.* (1987) found that by giving 3 kg B increased sugar contents from 17.15 t/ha and 18.2%.

El-Mashhadi (1988) treated sugar beet plants with B at a rate of 1 and 2 kg/fed. He found that application of 1 kg B/fed produced the highest% of sucrose and purity of root juice as compared with the other treatments.

Genaidy (1988) found that B fertilization with 2 Kg B/fed raised sugar% and purity by about 12 and 18%.

Moustafa (1989) reported that soaking sugar beet seeds in solution content 0, 20 or 40 ppm B for 24 hours before sowing were more effective on N content in both leaves and roots.

Shaker and Al-Roami (1989) showed that soaked sugar beet seeds in 0.05, 0.1 and 0.15% boric acid solution for 24 hours before sowing; all treatments were significantly affected purity% and crude sugar quality.

Saif (1991) reported that soil application of 0.50 kg B/fed gave the highest value of sucrose, TSS and purity percentage.

Toma, *et al.* (1991) found that application of B and Mo regulated nitrate reductase, glutamine synthetase and ATP as activities in sugar beet.

Castelo-Branco *et al.* (1993) found that variation in the concentration of various mineral elements in the leaves of sugar beet cv. Kaweinterpoly the leaf blade concentrations of Mo increased from young to the more nature leaves. No well defined Pattern was observed for B.

Li, *et al.* (1993) found that when seedlings of sugar beet cv. Shuangfeng 8 were cultured in solution with deficiencies of boron, deficiency symptoms of N, P, K, Ca or Mg were noted on the seedling shoots. The seedlings in the treatments with deficiency of boron had lower root weights than in controls given all nutrient elements.

Tariq, *et al.* (1993) reported that B application at 1, 2, 3 and 4 kg/ha significantly increased brix and purity%.

Czuba (1994) found that the foliar applications of INSOL-3, which contains B gave the largest sugar beet yield increases.

Domska (1996) found that sugar beet cv. AJ Poly and PN Mono-1 were given of soil applications 0.6 kg boron gave the highest sugar content as well as high root N, Na, K, NH_2-N and B contents.

Wrobel (1996) found that sugar beet cv. PN Mono-4 grown application of 2.0 kg B gave the highest root sugar content was highest and 4.0 kg Mo increased their concentrations in leaves and roots.

Nemeat Alla (1997) found that foliar spray with 1 g boric acid and 1 g molybdate ammonium solutions/l alone or combinations. Combinations between two microelements surpassed in total soluble solids and purity% compared with untreated plants.

Osman (1997) found that soil application with zero, 0.5 and 1 kg B/fed as a sodium borate 11% B and a mixtures (B + Mn) 0.5 + 0.02 kg/fed and 1 + 0.04 kg/fed as soil application insignificantly increased juice quality (TSS, sucrose and purity%).

Wrobel (1997) found that micronutrient B and Mo fertilization on contents of these elements in sugar beet (cv. PN Mono -4) roots increased with B and Mo in leaves as well as in roots. The highest sucrose percentage (18.3 %) in roots was obtained under Mo treatment.

Jaszczolt (1998) found that mineral fertilizers providing 30 g B, 20 g Mo/ha and 3.7 - 3.8 Kg B and Mo increased trace elements were more effective when applied during the period of rapid growth rather than at sowing.

Karamvandi and Malakouti (1998) revealed that 20 kg borasite/ha gave significant differences in purity%. The maximum sugar content (18.43%) was obtained with B treatment.

Gezgin, et al. (2000) studied the effect of four levels of boron fertilization (zero, 5, 10 and 20 kg/ha). They reported that boron levels had significant effect on sugar content.

Perveen, *et al.* (2000) found that 0 or 2 kg B/ha on the chemical composition of sugar beet cv. Keweterma. Sugar quality was not significantly affected by treatment.

Saif (2000) treated sugar beet Kawmera variety with four levels of boron (zero, 0.5, 1, and 1.5 kg B/fed). She found that the application of 0.5 kg B/fed was necessary to increase sucrose percentage in both seasons. In addition, the application of 0.5 kg. B/fed significantly increased juice purity percentage.

Osman, *et al.* (2003) found that increasing the level of B up to 2 kg/fed increased sucrose and purity%.

Enan (2004) found that soil application mixture 0.5 kg B/fed + 4 kg Zn/fed increased total soluble solids, sucrose, potassium% in root, lowest value Na% in roots, increased purity% and increased boron concentration in roots and leaves.

Nafei (2004) indicated that total soluble solids percentage was significantly increased as boron level was increased from zero to 0.500 kg boron sulfate/fed, However, sucrose percentage was significantly increased up to 0.750 kg B/fed. Purity percentage was significantly influenced by B rates added to sugar beet plants in both seasons.

Osman, *et al.* (2004) found that by increasing the level of boron increased significantly sucrose% in the 1st season.

c. Yield and its components:

Baginskas (1963) found that treating beet seeds with B and Mo had a marked effect on the yield.

Abd El-Hady (1969) stated that B application increased yield of sugar beet. The recommended dose was 20.25 kg B/fed as soil application.

Chelombitko (1970) found that foliar nutrition of 0.01% boric acid applied to sugar beet at the 5 to 8 leaf stage increased root yield.

El Kobbia, *et al.* (1971) showed that soil application of B at rate of 560 g B/ha in form of borax or 506 g in the form of boric acid as foliar nutrition raised the yield of roots in each experiment by about 6 tons/ha.

Hanousek (1973) investigated the effect of application the compound of trace elements fertilizer containing 6.37% of B at the rates of 0.30, 4.80 or 6.60 kg/ha to sugar beet plants. He found that application 0.3, 4.8 or up to 6.6 kg/ha increased root yield.

Zolotov and Lavrov (1973) studied the effect of the application of B by different method of sugar beet. They found that B gave the highest increase in root yields. Dusting seeds with boric acid at a rate of 50g /100 kg were the best application method.

Vlsyuk, *et al.* (1974) reported that sugar beet given B and Mo increased root and sugar yields by 2-8% and increased sugar yields by 0.46-1.06 t/ha.

Bedrinets, *et al.* (1975) reported that application of superphosphate enriched with Mo and B showed inconsistent effect on root yields of sugar beet.

Karvatskii (1975) found that application of superphosphate enriched with B and Mo increased root yields by 11-14% and sugar yields by 10-11%.

Omelchenko (1975) found that the treatment of sugar beet seeds with B and Mo increased root yield.

Sviridov (1975) added that the application of 1-3 kg B/ha increased average root yield by 1.7-2.5 t/ha and sugar yield by 470-700 kg/ha.

Kurbel (1976) found that a very high positive correlations between applied B and both root and sugar yields. These results were true when B dose increased up to 10 kg/ha as a foliar spray. He added that the maximum and economically optimum yields were obtained by the addition of 6.0 to 6.7 kg B/ha.

Meirmanov and Nuralin (1977) reported that seed treatment with 0.05 % ammonium molybdate solution increased root yields by 8.02 t/ha over 41.37 t which obtained by 0.8 % with Mo.

Tadorcic and Faller (1977) found that the application of B at 1.5 kg/ha decreased root and leaf yields of sugar beet plants.

Anikeev, *et al.* (1978) observed that the treatment seed of sugar beet with B increased root and sugar yields/ha by 26%.

Voth, *et al.* (1979) cleared that, in soils with PH 6-8, sugar beet yields were increased as a result of B application at a rate ranging from 2 to 3 lb/acre, while the addition of 4 lb/acre reduced the yields as compared to 2 lb/acre.

Krunic, *et al.* (1980) studied the effect of four different soil types given B as a foliar spray of microelement on sugar beet plants raised root yield in all types of soils.

Lashkevich (1980) reported that B had a positive effect on the sugar yields of sugar beet.

Ljubic (1980) reported that average root yield of sugar beet was increased due to the application of trace elements from 47.1 t/ha to 51.5 t/ha. The maximum yield was obtained by using 5 kg B/ha.

Antoniv (1981) stated that application of 2 kg B/ha to sugar beet increased root yield from 19.2 to 52.5 t/ha.

Ksenz and Putskaya (1983) studied the effect of foliar spray with 0.1% boric acid and 0.1% $MoNH_4$ each applied alone or in different combinations to sugar beet grown. The results cleared that the application of B was the effective treatment for increasing root yield.

Ewida, *et al.* (1984) cleared that B at rate of 100 ppm applied at harvest time gave the highest sugar yield/plant.

Gritsenko, *et al.* (1985) showed that the soaked sugar beet seeds in 0.02% boric acid solution increased yields of 45.2 ton root and 7.2 ton sugar/ha compared with 39.3 t and 6.1 t respectively for untreated seeds.

Shahin (1986) reported that the application of B at the rate of 50 ppm at 80 days from sowing increased root sugar yield, but 25 ppm increased foliage yield/fed.

Dragan, *et al.* (1987) found that by giving 3 kg B increased sugar beet root yields ranged from 17.15 t/ha and 18.2%.

El-Mashhadi (1988) treated sugar beet plants with B at a rate of 1 and 2 kg/fed. He found that application of 1 kg B/fed produced the highest sugar yield as compared with the other treatments.

Ibrahim, *et al.* (1988) studied the response of sugar beet to foliar spraying with microelement B. They found that the mixture of microelements gave the highest top, root and sugar yields.

Moustafa (1989) found that soaking sugar beet seeds in solutions cotained 0.20 or 40 ppm B solution for 24 hours before sowing showed insignificant increase in root yield.

Striva, *et al.* (1990) showed that foliar application of 0.6 Kg B/ha in mid July or 2 foliar applications of B in mid July and mid August gave average yields of 47.70, 48.08, 45.33 and 48.6 t. roots and 5.24, 5.41, 5.07 and 5.40 t. sugar/ha.

Saif (1991) reported that soil application of 0.5 kg B/fed produced a significant increase in yields of tops, roots and sugar t/fed.

Hassanin and Abuldahab (1991) treated sugar beet plants by foliar applications of 0.03 or 0.05% B or mixture of 0.03% B + 0.2% Mn or 0.05% B + 0.4% Mn. Application of B increased sugar and root yields compared with the untreated control. Mixed application of B + Mn produced the highest root and sugar yields.

Tariq, *et al.* (1993) reported that the application of B to sugar beet crops at a rate of 1, 2, 3 and 4 kg/ha significantly increased root yield.

Czuba (1994) found that the foliar applications of INSOL-3, which contains B gave the largest yield increases of sugar beet.

Domska (1996) found that soil application of 0.6 kg boron gave the highest root, shoot and sugar yield.

Wrobel (1996) found that sugar beet cv. PN Mono-4 grown application of 2.0 Kg B and 4.0 Kg Mo gave the highest root and sugar yields.

Nemeat Alla (1997) found that foliar pray with 1 g boric acid and 1 g molybdate ammonium solutions/L alone or combinations. Combinations between two microelements surpassed in top, root and sugar yields compared with untreated plants.

Osman (1997) found that soil application with zero, 0.5 and 1 kg B/fed as a sodium borate 11% B and a mixtures (B + Mn) 0.5 + 0.02 kg/fed and 1 + 0.04 kg/fed as soil application insignificantly increased yield and yield components (top, root and sugar yields ton/fed.).

Wrobel (1997) found that micronutrient B and Mo fertilization on yield and sugar in sugar beet (cv. PN Mono -4) roots increased with B and Mo.

Jaszczolt (1998) found that mineral fertilizers providing 30 g B, 20 g Mo/ha and 3.7 - 3.8 Kg B and Mo increased yield of roots and sugar were more effective when applied during the period of rapid growth rather than at sowing.

Karamvandi and Malakouti (1998) revealed that 20 kg borasite/ha gave significant differences in root yield and sugar yield. The maximum root yields (45.89 t/ha) were obtained with B treatment. There was also an increase of 17.36% in sugar yield compared with the control treatment. Sugar yield of B treatments was 13.74 % higher than the control.

Witek (1998) studied the effect of foliar application of B in 2 or 3 doses, and found that root yield was highest with 2 applications of trace elements in solution (51.13 t/ha) compared with 37.90 t/ha for the control. Top yield was 17.17 t/ha in the control and 28.47 t/ha with 2 applications of trace elements. Sugar yield was also highest (9.51 t) with 2 applications of trace elements.

Gezgin, *et al.* (2000) studied the effect of four levels of boron fertilization (zero, 5, 10 and 20 kg/ha.). They found that the highest root yield (62.8 t/ha) was obtained from 20 kg boron/ha which were 4.1% higher than those lacking boron application.

Perveen, *et al.* (2000) found that 0 or 2 kg B/ha on the chemical composition of sugar beet cv. Keweterma. Sugar beet yields were not significantly affected by treatment.

Saif (2000) treated sugar beet Kawemira variety with four levels of boron (zero, 0.5, 1, and 1.5 kg B/fed). She found that the applied doses of boron fertilizer produced significant effect on root fresh weight yield, and 0.5 kg. B/fed. raised root fresh weight yield 43.9 %, 23.4% and 32.6% over this of unfertilized treatment in the 1st and 2nd seasons and their combined, respectively.

Osman, *et al.* (2003) found that increasing the level of B up to 2 kg B/fed increased sugar yield (ton/fed).

Enan (2004) found that soil application 0.5 kg B/fed and mixture 0.5 kg B/fed + 4 kg Zn/fed increased root yield and significantly increased top and sugar yield.

Nafei (2004) indicated that sugar yield was significantly increased as boron level was increased from zero to 500 g boron sulfate/fed, However, root yield was significantly influenced by B rates added to sugar beet plants in both seasons.

Osman, *et al.* (2004) concluded that increasing the level of B increased significantly the biological yield, root and sugar yields and top yield.

MATERIALS AND METHODS

MATERIALS AND METHODS

Two field trials were carried out in Sakha Agricultural Research Station, Kafr EL-Sheikh Governorate on sugar beet crop in two successive seasons of 2002/2003 and 2003/2004.

Each experiment included 27 treatments which were the combinations between three types of sugar beet, three levels of boron and three levels of molybdenum.

a. Sugar beet varieties:

1. Type E (Montebianco): This type characterized with higher root yield and lower sugar recovery.
2. Type N (Kawemira): This type characterized with moderate root yield and moderate sugar recovery.
3. Type Z (Gloria): This type characterized with lower root yield and higher sugar recovery.

b. Boron levels:

1. Zero (control).
2. 0.50 kg B/fed.
3. 1.00 kg B/fed.

Boron was applied as sodium borate ($Na_2B_4O_7.10\ H_2O$) (11% B).

c. Molybdenum levels:

1. Zero (control).
2. 0.25 kg Mo/fed.
3. 0.50 kg Mo/fed.

Molybdenum was applied as ammonium molybdate $(NH_4)_6 Mo_7 O_{24}. 4 H_2O$ (54% Mo).

The mechanical and chemical analysis of the experimental soil is presented in Table (1). The meteorological parameters are presented in Table (2).

All micronutrients treatments were added singly or in combinations with each other and were mixed with an appropriate amount of sand and applied once as soil application with the second dose of nitrogen fertilizer (after 75 days from sowing).

Nitrogen fertilizer was applied at 80 kg N/fed as Urea (46% N), in two equal doses, the first one after thinning (45 days from sowing) and the second one month later. Phosphorus fertilizer at 30 kg P_2O_5/fed as calcium super phosphate (15.5% P_2O_5) and potassium fertilizer at 48 kg K_2O/fed as potassium sulphate (48% K_2O) were applied in both seasons.

Phosphorus fertilizer was applied at seedbed preparation, whereas potassium fertilizer dose was applied once with the first dose of nitrogen.

The experiments were laid out in a split plot design with three replications, where varieties were allocated in the main plots and the combinations between boron and molybdenum levels were distributed at random in the sub-plots. Plot area was

Table (1): Mechanical and chemical analysis of the experimental soil (2002/2003 and 2003/2004 seasons)

Season / Soil depth (cm)	2002/2003 / 0-30	2003/2004 / 0-30
Mechanical soil distribution		
Sand %	26.75	33.50
Silt %	40.90	38.80
Clay %	31.30	26.50
Chemical analysis in soil extraction		
a) Cations mg/L		
Ca^{++}	0.18	0.16
Na^{+}	0.22	0.42
K^{+}	0.08	0.16
b) Anions mg/L		
Cl^{-}	0.15	0.18
SO_4^{--}	0.10	0.13
$CaCO_3$	0.15	0.21
HCo_3^{-}	1.25	1.18
Available B ppm	0.41	0.45
Available Mo ppm	9.55	10.00
Available N ppm	38.20	39.40
Available P ppm	18.20	19.80
Available K ppm	395.2	385.40
pH	8.00	8.20
E.C ds m	2.18	2.25

Soil physical and chemical properties were determined according to **Jackson (1956)**.

Table (2): Metrological parameters of the experimental sites

Month	2002/2003							2003/2004						
	Air temperature °C		Relative humidity %		Soil temperature °C depth 20 cm		Total rain fall (mm)	Air temperature °C		Relative humidity %		Soil temperature °C depth 20 cm		Total rain fall (mm)
	Max.	Min.	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	Max.	Min.	
September	32.1	19.8	95.0	34.0	30.2	23.4	-	30.4	18.7	96.0	38.0	32.3	22.7	-
October	28.3	17.0	94.0	44.0	27.9	19.8	-	29.8	17.4	96.0	38.0	31.2	23.1	-
November	25.4	12.8	95.0	42.0	22.4	15.8	-	22.4	12.5	95.0	46.0	24.3	13.4	-
December	19.9	9.3	95.0	48.0	15.8	10.3	-	20.1	9.2	94.0	47.0	18.0	8.4	14.0
January	20.0	8.0	94.0	45.0	15.9	9.1	16.0	17.3	7.4	94.0	49.0	10.1	10.3	62.0
February	16.7	6.9	94.0	46.0	14.1	7.0	109.0	19.0	7.2	96.0	46.0	14.2	11.2	89.0
March	21.1	9.5	96.0	42.0	18.7	7.9	44.0	23.2	8.0	96.0	39.0	15.3	13.7	-
April	24.2	11.5	95.0	37.0	24.4	13.4	-	25.0	11.6	96.0	33.0	18.6	16.5	-
May	29.8	16.9	95.0	31.0	31.5	19.9	-	27.9	16.8	93.0	34.0	21.4	19.5	-
June	31.2	19.8	96.0	36.0	36.0	22.7	-	29.5	18.8	96.0	38.0	22.2	20.4	-

Source: Central Laboratory for Agricultural Climate, Agricultural Research Center. Giza, Egypt.

17.5 m^2. Each plot contained five ridges which were 7 meter in length, 50 cm in width and 20 cm between hills.

The preceding crop was rice in both seasons. All cultural practices for growing sugar beet were done as recommended.

Sowing date was on the 5th of October in both seasons and harvesting date was after 7 months.

Data recorded:

I. Growth criteria and juice quality:

The following characters were studied:

A sample of five plants was taken at random from each sub-plot after 120, 150, 180 days from sowing to determine the following growth characters and juice quality constituents.

1. Root length (cm).
2. Root diameter (cm).
3. Root fresh weight /plant (gm).
4. Top fresh weight /plant (gm).
5. Total soluble solids percentage, (TSS %) was determined by using hand refractometer **(A.O.A.C.,1995)**.
6. Sucrose percentage was determined by using Saccharimeter according to them method described by **Le Docte (1927)**.
7. Purity percentage was calculated according **Carruthers *et al.* (1962)** as follows:

Purity = (sucrose % X 100) / TSS %.

II. Chemical constituents:

At harvest (210 days from sowing), a sample of five plants was taken at random to determine the above mentioned characters in addition to the following chemical constituents. To determine the following elements a sample of 100 gm of the different parts of the plant (roots, petioles, and blades) was taken randomly from each sub-plot where grinded and ovened at 70 °C.

A dried sample of 0.1 gm from each part of the plants digested by using sulfuric acid and the following elements were determined:

1. Nitrogen percentage in roots, petioles and blades were determined using micro Kjldahl apparatus according to **Pergl (1945)**.
2. Potassium and sodium percentage in roots, petioles and blades were determined in the digested solution using flame photometer according to **Brown and Lilliland (1964)**.
3. Boron and molybdenum in mg/100g dry matter in roots,petioles and blades were determined as described in Flame Method, Manual for Atomic Absorption, and Model 22Brooklyn AVE at 213 nm as given by the **(A.O.A.C., 1995)**.

Also, TSS %, sucrose percentage and purity % were determined.

III. Yield and its components:

At harvest, plants of three guarded ridges were uprooted and topped to estimate:

1. Yield of fresh roots (ton/fed).
2. Yield of tops (ton/fed).
3. Sugar yield (ton/fed) was calculated according the following equation:

    Sugar yield (ton/fed) = Root yield (ton/fed) X sucrose %.

Statistical analysis:

The data of both experiments (each year) were subjected to proper statistical analysis of variance according to **Sendecor and Cochran (1967).** The heterogeneity of error variances across seasons indicated that error terms were homogeneous. The combined analysis was conducted for the data of the two seasons according to **Gomez and Gomez (1984)**. For comparison between means, Duncan's multiple range test was used **(Duncan, 1955)**.

RESULTS AND DISCUSSION

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

Table (3): Seasonal effect on some morphological and juice quality of sugar beet crop at different growth stages

Seasons (S)	Root length (cm)	Root diameter (cm)	Root fresh weight (gm)	Top fresh weight (gm)	Total soluble solids %	Sucrose %	Purity %
120 days from sowing							
2002/03	17.31 a	8.14 a	410.6 b	805.7 a	15.33 a	10.64 a	69.74 a
2003/04	17.73 a	8.58 a	464.1 a	825.1 a	14.61 b	9.58 b	65.87 b
150 days from sowing							
2002/03	19.35 a	9.19 a	622.7 b	1001.2 a	18.14 a	13.13 a	72.78 a
2003/04	19.73 a	9.54 a	635.6 a	1022.9 a	17.63 b	13.03 a	74.22 a
180 days from sowing							
2002/03	22.40 a	11.17 a	839.8 a	540.8 a	21.25 a	15.18 a	71.66 b
2003/04	21.39 b	10.23 a	840.3 a	540.5 a	20.08 b	15.19 a	76.01 a

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 1st 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 °C for air temperature) and (15.9 & 10.1 °C for soil temperature) at the 1st and 2nd 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.

Table (4): Varietal performance with relation to growth criteria of some sugar beet varieties at different stages (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Root length (cm)			Root diameter (cm)			Root fresh weight (gm)			Top fresh weight (gm)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
120 days from sowing												
Montebianco	18.07 a	19.25 a	18.66 a	9.43 a	8.88 a	9.15 a	478.0 a	470.3 a	474.2 a	787.2 a	836.7 a	812.0 a
Kawemira	17.90 a	18.00 b	17.95 a	8.04 b	8.10 a	8.07 ab	405.7 b	498.5 a	452.1 a	832.9 a	830.6 a	831.8 a
Gloria	15.98 b	15.59 c	15.96 b	6.98 c	8.77 a	7.87 b	348.3 c	423.5 b	385.9 b	797.2 a	808.0 a	802.6 a
F.Test (V X S)	-		NS	-		NS	-		*	-		NS
150 days from sowing												
Montebianco	20.12 a	21.20 a	20.66 a	10.43 a	9.76 a	10.10 a	656.6 a	656.0 a	656.3 a	983.6 a	1036.0 a	1010.0 a
Kawemira	19.90 ab	20.06 b	19.98 a	9.17 b	9.12 a	9.15 ab	606.6 b	637.8 a	622.2 b	1025.0 a	1028.0 a	1027.0 a
Gloria	18.05 b	17.95 c	18.00 b	7.98 c	9.75 a	8.86 b	605.0 b	613.2 a	609.1 b	994.8 a	1005.0 a	999.8 a
F.Test (V X S)	-		NS	-		NS	-		*	-		NS
180 days from sowing												
Montebianco	23.22 a	22.87 a	23.04 a	12.40 a	10.49 a	11.44 a	876.4 a	873.0 a	874.7 a	577.2 a	573.0 a	575.1 a
Kawemira	22.93 a	21.75 b	22.34 b	11.15 b	9.75 a	10.45 b	829.9 b	831.9 b	830.9 b	530.6 b	531.9 b	531.3 b
Gloria	21.06 b	19.57 c	20.32 c	9.97 c	10.44 a	10.21 b	813.4 b	816.3 b	814.9 c	514.6 b	516.6 b	515.6 c
F.Test (V X S)	-		*	-		*	-		NS	-		NS

* : significant , NS : not significant

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

Table (5): Varietal performance with relation to juice quality percentages of some sugar beet varieties at different growth stages (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Total soluble solids %			Sucrose %			Purity %		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
120 days from sowing									
Montebianco	15.71 a	14.83 a	15.27 a	9.29 b	8.45 c	8.87 c	59.31 b	57.40 c	58.18 c
Kawemira	15.30 ab	14.70 a	15.00 b	10.77 ab	9.29 b	10.03 b	70.63 ab	63.30 b	66.96 b
Gloria	15.01 b	14.29 b	14.65 c	11.88 a	11.00 a	11.44 a	79.29 a	77.28 a	78.28 a
F.Test (V X S)	-		NS	-		NS	-		NS
150 days from sowing									
Montebianco	18.60 a	17.86 a	18.23 a	10.87 c	10.89 c	10.88 c	58.51 c	61.08 c	59.79 c
Kawemira	18.12 b	17.63 a	17.88 b	12.94 b	12.95 b	12.94 b	71.60 b	73.63 b	72.61 b
Gloria	17.72 c	17.42 a	17.57 b	15.60 a	15.27 a	15.43 a	88.25 a	87.96 a	88.10 a
F.Test (V X S)	-		NS	-		NS	-		NS
180 days from sowing									
Montebianco	21.59 a	20.34 a	20.96 a	12.86 c	13.11 c	12.99 c	59.65 c	64.70 c	72.17 c
Kawemira	21.18 ab	20.07 b	20.62 b	15.01 b	15.05 b	15.03 b	71.02 b	75.28 b	73.15 b
Gloria	20.99 b	19.83 c	20.41 c	17.67 a	17.43 a	17.55 a	84.33 a	88.07 a	86.20 a
F.Test (V X S)	-		NS	-		NS	-		NS

* : significant , NS : not significant

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.

Table (6): Effect of boron fertilizers on growth criteria of sugar beet at different growth stages (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Root length (cm)			Root diameter (cm)			Root fresh weight (gm)			Top fresh weight (gm)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
120 days from sowing												
zero	16.18 c	16.37 b	16.28 c	7.33 c	8.14 b	7.73 c	395.0 b	460.3ab	427.6 b	785.5 a	849.1 a	817.3 a
0.50	17.40 b	18.17 a	17.78 b	8.14 b	8.56a b	8.35 b	391.8 b	478.6 a	435.2ab	816.8 a	803.1 a	809.9 a
1.00	18.37 a	18.65 a	18.51 a	8.98 a	9.05 a	9.01 a	445.2 a	453.4 b	449.3 a	815.0 a	823.2 a	819.1 a
F.Test(B X S)	-		NS	-		NS	-		*	-		NS
150 days from sowing												
zero	18.23 c	18.44 b	18.34 c	8.53 c	9.20 b	8.86 b	609.7 b	626.6 a	618.2 b	976.9 a	1046.0a	1011.0a
0.50	19.44 b	20.11 a	19.78 b	9.09 b	9.42 ab	9.25 b	623.7ab	635.6 a	629.7ab	1021.0a	1002.0a	1011.0a
1.00	20.40 a	20.65 a	20.52 a	9.96 a	10.02 a	9.99 a	634.7 a	644.8 a	639.8 a	1006.0a	1021.0a	1014.0a
F.Test(B X S)	-		NS	-		NS	-		NS	-		NS
180 days from sowing												
zero	21.17 c	20.06 b	20.62 c	10.38 c	9.81 b	10.10 c	821.5 b	828.0 b	824.7 b	522.6 b	528.0 b	525.3 b
0.50	22.53 b	21.83 a	22.18 b	11.15 b	10.21ab	10.68 b	846.1 a	846.0 a	846.1 a	546.5 a	546.2 a	546.3 a
1.00	23.51 a	22.30 a	22.90a	11.99 a	10.67 a	11.33 a	852.1 a	847.2 a	849.6 a	553.6 a	547.3 a	550.4 a
F.Test(B X S)	-		NS	-		NS	-		NS	-		NS

* : significant , NS : not significant

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.

Table (7): Effect of boron fertilizers on juice quality percentages of sugar beet roots at different growth stages (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Total soluble solids %			Sucrose %			Purity %		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
120 days from sowing									
zero	15.68 a	14.99 a	15.34 a	10.27 a	9.72 a	9.99 a	65.76 b	64.97 b	65.37 b
0.50	15.19 b	14.31 b	14.5 b	10.75 a	9.60 a	10.18 a	71.08 a	67.60 a	69.34 a
1.00	15.14 b	14.53 b	14.84 b	10.92 a	9.42 a	10.17 a	72.39 a	65.04 b	68.71 a
F.Test(B X S)	-		NS	-		*	-		*
150 days from sowing									
zero	18.38 a	17.92 a	18.15 a	12.81 b	12.63 b	12.72 b	70.07 b	70.71 b	70.39 c
0.50	18.15 ab	17.40 b	17.78 b	13.05 b	12.96 b	13.00 b	72.26 b	74.83 a	73.54 b
1.00	17.91 b	17.59 b	17.75 b	13.55 a	13.52 a	13.53 a	76.02 a	77.12 a	76.57 a
F.Test(B X S)	-		NS	-		NS	-		NS
180 days from sowing									
zero	21.55 a	20.39 a	20.97 a	14.82 b	14.75 b	14.79 c	68.98 c	72.69 b	70.83 c
0.50	21.19 b	19.85 b	20.52 b	15.15 ab	15.14 b	15.15 b	71.76 b	76.70 a	74.23 b
1.00	21.02 b	20.00 b	20.51 b	15.57 a	15.69 a	15.63 a	74.27 a	78.66 a	76.46 a
F.Test(B X S)	-		NS	-		NS	-		NS

* : significant , NS : not significant

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)**.

Table (8): Effect of molybdenum fertilizers on growth criteria of sugar beet at different growth stages (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kg Mo/fed)	Root length (cm)			Root diameter (cm)			Root fresh weight (gm)			Top fresh weight (gm)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
120 days from sowing												
zero	16.38 c	16.06 c	16.22 c	7.93 b	7.80 c	7.87 c	374.7 c	434.0 c	404.4 c	695.6 b	810.4 a	753.0 b
0.25	17.07 b	17.90 b	17.49 b	8.07 ab	8.49 b	8.28 b	411.9 b	467.9 b	439.9 b	854.5 a	843.8 a	844.6 a
0.50	18.49 a	19.23 a	18.86 a	8.44 a	9.45 a	8.94 a	445.4 a	490.5 a	467.9 a	867.2 a	830.2 a	848.7 a
F.Test(Mo X S)	-		*	-		*	-		NS	-		*
150 days from sowing												
zero	18.37 c	18.06 c	18.22 c	8.98 a	8.76 c	8.87 c	580.7 c	636.9ab	608.8 c	899.8 b	1010.0a	955.1 b
0.25	19.16 b	19.98 b	19.57 b	19.17 a	9.46 b	9.32 b	629.9 b	620.1 b	625.0 b	1048.0a	1032.0a	1040.0a
0.50	20.54 a	21.17a	20.86 a	9.43 a	10.42 a	9.93 a	657.9 a	650.1 a	653.9 a	1056.0a	1027.0a	1041.0a
F.Test(Mo X S)	-		*	-		*	-		*	-		*
180 days from sowing												
zero	21.37 c	19.20 c	20.28 c	10.81 b	8.78 c	9.80 c	812.9 c	811.8 c	812.3 c	514.2 c	511.9 c	513.0 c
0.25	22.26 b	20.82 b	21.54 b	11.17ab	10.42 b	10.80 b	840.5 b	839.3 b	839.9 b	541.3 b	539.3 b	540.3 b
0.50	22.58 a	24.17 a	23.88 a	11.53 a	11.49 a	11.51 a	866.3 a	870.1 a	868.2 a	567.0 a	570.3 a	568.7 a
F.Test(Mo X S)	-		*	-		*	-		NS	-		NS

* : significant , NS : not significant

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

Table (9): Effect of molybdenum fertilizers on juice quality percentage of sugar beet at different growth stages (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kg Mo/fed)	Total soluble solids %			Sucrose %			Purity %		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
120 days from sowing									
zero	15.66 a	15.29 a	15.48 a	10.47 a	9.79 a	10.13 a	67.08 b	64.12 b	65.60 b
0.25	15.36 b	14.57 b	14.96 b	10.69 a	9.62 ab	10.15 a	69.87 ab	66.25 ab	68.06 ab
0.50	15.00 c	13.97 c	14.48 c	10.78 a	9.33 b	10.06 a	72.27 a	67.25 a	69.76 a
F.Test(Mo X S)	-		*	-		NS	-		NS
150 days from sowing									
zero	18.47 a	18.07 a	18.27 a	12.34 c	12.42 c	12.38 c	67.11 c	68.88 c	68.00 c
0.25	18.18 b	17.64 b	17.91 b	13.24 b	13.02 b	13.13 b	73.12 b	74.08 b	73.60 b
0.50	17.80 c	17.21 c	17.50 c	13.82 a	13.67 a	13.74 a	78.11 a	79.71 a	78.91 a
F.Test(Mo X S)	-		NS	-		NS	-		NS
180 days from sowing									
zero	21.59 a	20.89 a	21.24 a	14.32 c	14.52 c	14.42 c	66.49 c	69.67 c	68.08 c
0.25	21.30 b	20.35 b	20.83 b	15.17 b	15.20 b	15.18 b	71.37 b	74.84 b	73.10 b
0.50	20.86 c	18.99 c	19.93 c	16.05 a	15.87 a	15.96 a	77.15 a	83.54 a	80.34 a
F.Test(Mo X S)	-		*	-		NS	-		NS

* : significant , NS : not significant

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).

Table (10): Effect of interaction between varieties and boron on root fresh weight/ plant (gm) of some sugar beet varieties at 120 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	zero	0.50	1.00	zero	0.50	1.00
Montebianco	456.8 b	470.4 ab	506.9 a	437.3 b	459.6 bcd	464.0 bc	442.1 a	465.0 a	485.4 a
Kawemira	397.2 c	390.6 c	429.2 bc	458.3 bcd	551.0 a	486.2 b	427.8 b	470.8 a	457.7 a
Gloria	331.0 d	314.3 d	399.6 c	435.2 cde	425.2 de	410.1 e	383.1 cd	369.8 d	404.8 bc
F.Test (V X B X S)	-			-			*		

Table (11): Effect of interaction between varieties and boron on top fresh weight/ plant (gm) of some sugar beet varieties at 120 and 150 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	zero	0.50	1.00	zero	0.50	1.00
120 days from sowing									
Montebianco	780.1 b	834.2 ab	747.3 b	870.3 a	858.3 a	781.4 a	825.2 ab	846.3 ab	746.4 b
Kawemira	740.6 b	854.7 ab	912.4 a	842.1 a	788.6 a	861.2 a	791.3 b	817.1 ab	886.8 a
Gloria	835.9 ab	770.6 b	785.1 b	834.9 a	762.3 a	826.9 a	835.4 ab	766.4 b	806.0 ab
F.Test (V X B X S)	-			-			NS		
150days from sowing									
Montebianco	971.6 bc	1023.0 abc	956.2 bc	1070.0 a	1057.0 a	979.7 a	1021.0 ab	1040.0 ab	967.9 b
Kawemira	923.1 c	1061.0 ab	1092.0 a	1040.0 a	988.8 a	1056.0 a	981.7 b	1025.0 ab	1074.0 a
Gloria	1036.0 abc	978.4 abc	970.0 bc	1027.0 a	960.0 a	1027.0 a	1031.0 ab	969.4 b	998.4 ab
F.Test (V X B X S)	-			-			NS		

* : significant , NS : not significant

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

Table (12): Seasonal effect on some morphological and juice quality of sugar beet crop at harvest (2002/03 and 2003/04 seasons)

Seasons (S)	Root length (cm)	Root diameter (cm)	Root fresh weight (gm)	Top fresh weight (gm)	Total soluble solids %	Sucrose %	Purity %
2002/03	26.67 a	13.01 a	960.98 a	380.11 a	24.23 a	17.15 a	70.99 b
2003/04	26.69 a	13.59 a	963.46 a	390.95 a	23.68 b	17.14 a	72.57 a

Table (13): Seasonal effect on boron and molybdenum concentrations (ppm) of sugar beet crop at harvest (2002/03 and 2003/04 seasons)

Seasons (S)	Boron (ppm) in root	Boron (ppm) in petiole	Boron (ppm) in blade	Molybdenum (ppm) in root	Molybdenum (ppm) in petiole	Molybdenum (ppm) in blade
2002/03	12.76 a	29.57 a	29.99 a	4.43 a	4.47 a	5.09 a
2003/04	12.51 a	28.79 a	29.90 a	4.30 a	5.00 a	5.29 a

Table (14): Seasonal effect on nitrogen, potassium and sodium percentages of sugar beet crop at harvest (2002/03 and 2003/04 seasons)

Seasons (S)	Nitrogen % in root	Nitrogen % in petiole	Nitrogen % in blade	Potassium % in root	Potassium % in petiole	Potassium % in blade	Sodium % in root	Sodium % in petiole	Sodium % in blade
2002/03	1.56 a	2.43 a	3.47 a	1.74 a	3.07 a	3.27 a	2.13 a	3.94 a	4.06 b
2003/04	1.34 b	2.40 a	3.55 a	1.54 a	2.85 a	3.32 a	2.26 a	3.98 a	4.36 a

Table (15): Seasonal effect on root, sugar and top yield of sugar beet crop at harvest (2002/03 and 2003/04 seasons)

Seasons (S)	Root yield (ton/fed)	Top yield (ton/fed)	Sugar yield (ton/fed)
2002/03	28.77 a	12.38 a	4.92 a
2003/04	28.90 a	12.77 a	4.94 a

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

Table (16): Varietal performance with relation to growth criteria of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Root length (cm)			Root diameter (cm)			Root fresh weight (gm)			Top fresh weight (gm)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	28.27 a	28.16 a	28.22 a	14.45 a	13.88 a	14.16 a	997.6 a	1000.0a	999.0 a	407.4 a	440.0 a	423.7 a
Kawemira	26.90 b	27.11 b	27.01 b	13.19 b	13.13 a	13.16 ab	951.0 b	952.6 b	951.8 b	397.5 a	400.4 b	399.0 a
Gloria	24.84 c	24.83 c	24.83 c	11.42 c	13.77 a	12.60 b	934.3 b	937.3 c	935.8 c	335.4 b	332.4 c	334.0 b
F.test (VXS)			NS			*			NS			NS

Table (17): Varietal performance with relation to juice quality percentage of some sugar beet roots at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Total soluble solids %			Sucrose %			Purity %		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	24.63 a	23.98 a	24.31 a	14.97 c	15.00 c	14.98 c	60.83 c	62.61 c	61.72 c
Kawemira	24.21 b	23.71 b	23.96 b	17.06 b	17.01 b	17.04 b	70.75 b	71.85 b	71.21 b
Gloria	23.87 c	23.36 c	23.61 c	19.44 a	19.42 a	19.43 a	81.59 a	83.27 a	82.43 a
F.test (V X S)			NS			NS			NS

* : significant , NS : not significant

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.

Table (18): Varietal performance with relation to boron concentrations (ppm) in the different plant organs of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Boron (ppm) in root			Boron (ppm) in petiole			Boron (ppm) in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	12.58 a	12.26 a	12.42 a	28.10 c	27.37 c	27.73 c	28.56 c	28.43 b	28.50 c
Kawemira	12.88 a	12.46 a	12.67 a	29.48 b	28.96 b	29.22 b	29.97 b	30.08 a	30.02 b
Gloria	12.83 a	12.82 a	12.82 a	31.15 a	30.06 a	30.60 a	31.45 a	31.21 a	31.33 a
F.test (V X S)			NS			NS			NS

Table (19): Varietal performance with relation to molybdenum concentrations (ppm) in the different plant organs of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Molybdenum (ppm) in root			Molybdenum (ppm) in petiole			Molybdenum (ppm) in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	4.51 a	4.20 a	4.35 a	4.72 a	4.93 a	4.83 a	5.21 a	5.25 a	5.23 a
Kawemira	4.32 a	4.26 a	4.29 a	4.81 a	5.32 a	5.06 a	5.13 a	5.31 a	5.22 a
Gloria	4.45 a	4.44 a	4.44 a	4.70 a	4.97 a	4.84 a	4.93 a	5.29 a	5.11 a
F.test (V X S)			NS			NS			NS

Table (20): Varietal performance with relation to nitrogen percentages in the different plant organs of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Nitrogen % in root			Nitrogen % in petiole			Nitrogen % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	1.66 a	1.32 a	1.49 a	2.29 b	2.45 a	2.37 a	3.54 a	3.59 a	3.56 a
Kawemira	1.65 a	1.34 a	1.49 a	2.37 a	2.43 a	2.40 a	3.39 a	3.50 a	3.44 a
Gloria	1.38 b	1.36 a	1.37 b	2.62 a	2.33 a	2.48 a	3.50 a	3.57 a	3.53 a
F.test (V X S)			*			*			NS

* : significant , NS : not significant

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

Table (21): Varietal performance with relation to potassium percentages in the different plant organs of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Potassium % in root			Potassium % in petiole			Potassium % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	2.02 a	1.84 a	1.93 a	3.24 a	2.94 a	3.09 a	3.39 a	3.40 a	3.39 a
Kawemira	1.80 ab	1.41 b	1.60 b	3.18 a	2.92 a	3.05 a	3.42 a	3.36 a	3.39 a
Gloria	1.40 b	1.36 b	1.38 b	2.79 b	2.68 a	2.74 b	2.99 a	3.19 a	3.09 a
F.Test (V X S)			NS			NS			NS

Table (22): Varietal performance with relation to sodium percentages in the different plant organs of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Sodium % in root			Sodium % in petiole			Sodium % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	2.23 a	2.31 a	2.27 a	4.07 a	4.14 a	4.11 a	4.12 a	4.29 a	4.20 a
Kawemira	2.29 a	2.21 a	2.25 a	3.85 a	3.86 b	3.85 a	4.01 a	4.42 a	4.21 a
Gloria	1.86 b	2.27 a	2.07 b	3.90 a	3.95 b	3.93 a	4.05 a	4.37 a	4.21 a
F.test (V X S)			*			NS			NS

Table (23): Varietal performance with relation to yield of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	Root yield (ton/fed)			Top yield (ton/fed)			Sugar yield (ton/fed)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Montebianco	29.93 a	30.01 a	29.97 a	13.22 a	14.20 a	13.71 a	4.48 c	4.50 c	4.49 c
Kawemira	28.58 b	28.58 b	28.58 b	12.87 a	13.01 b	12.94 a	4.88 b	4.87 b	4.87 b
Gloria	27.81 c	28.12 c	27.96 c	11.06 b	10.98 c	11.02 b	5.41 a	5.46 a	5.43 a
F.test (V X S)			NS			NS			NS

* : significant , NS : not significant

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.

Table (24): Effect of boron fertilizers on growth criteria of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Root length (cm)			Root diameter (cm)			Root fresh weight (gm)			Top fresh weight (gm)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	25.59 c	25.38 b	25.49 c	11.99 c	13.19 b	12.59 c	942.1 b	948.4 b	945.3 b	339.1 c	346.5 b	342.8 c
0.50	26.63 b	27.05 a	26.84 b	13.07 b	13.57ab	13.32 b	967.1 a	967.0 a	967.0 a	384.3 b	405.4 a	394.9 b
1.00	27.79 a	27.67 a	27.73 a	14.00 a	14.02 a	14.01 a	973.7 a	975.1 a	974.4 a	416.9 a	421.0 a	419.0 a
F.test (B X S)			NS			*			NS			NS

Table (25): Effect of boron fertilizers on juice quality percentages of sugar beet roots at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Total soluble solids %			Sucrose %			Purity %		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	24.62 a	24.09 a	24.35 a	16.79 b	16.83 b	16.81 b	68.39 c	69.99 b	69.19 c
0.50	24.14 b	23.48 b	23.81 b	17.13 ab	17.11 ab	17.12 b	71.16 b	73.07 a	72.11 a
1.00	23.95 b	23.49 b	23.72 b	17.54 a	17.50 a	17.52 a	73.44 a	74.67 a	74.06 a
F.test (B X S)			NS			NS			NS

* : significant , NS : not significant

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

Table (26): Effect of boron fertilizers on boron concentrations (ppm) in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Boron (ppm) in root			Boron (ppm) in petiole			Boron (ppm) in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Zero	11.32 c	11.32 b	11.32 c	28.64 c	28.23 b	28.43 c	29.35 b	29.44 b	29.40 b
0.50	12.82 b	13.17 a	13.00 b	29.55 b	29.08 a	29.32 b	29.64 b	29.70 b	29.67 b
1.00	14.15 a	13.05 a	13.60 a	30.53 a	29.08 a	29.80 a	30.99 a	30.57 a	30.78 a
F.test (B X S)			*			*			NS

Table (27): Effect of boron fertilizers on molybdenum concentrations (ppm) in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Molybdenum (ppm) in root			Molybdenum (ppm) in petiole			Molybdenum (ppm) in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	3.99 c	3.73 b	3.86 c	4.69 b	5.03 a	4.86 b	5.02 a	5.33 a	5.17 a
0.50	4.33 b	4.58 a	4.46 b	4.99 a	5.10 a	5.05 a	5.19 a	5.31 a	5.25 a
1.00	4.96 a	4.60 a	4.78 a	4.55 b	5.08 a	4.82 b	5.06 a	5.22 a	5.14 a
F.test (B X S)			*			*			NS

Table (28): Effect of boron fertilizers on nitrogen percentages in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Nitrogen % in root			Nitrogen % in petiole			Nitrogen % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	1.60 a	1.30 a	1.45 a	2.40 a	2.41 a	2.40 a	3.44 a	3.52 a	3.48 b
0.50	1.54 a	1.33 a	1.43 a	2.48 a	2.36 a	2.42 a	3.46 a	3.52 a	3.49 b
1.00	1.55 a	1.40 a	1.47 a	2.40 a	2.44 a	2.42 a	3.51 a	3.62 a	3.57 a
F.test (B X S)			NS			NS			NS

* : significant , NS : not significant

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.

Table (29): Effect of boron fertilizers on potassium percentages in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Potassium % in root			Potassium % in petiole			Potassium % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Zero	1.75 a	1.43 a	1.59 a	3.09 a	2.74 a	2.92 a	3.20 a	3.17 a	3.18 a
0.50	1.77 a	1.53 ab	1.65 a	3.07 a	2.85 a	2.96 a	3.30 a	3.34 a	3.32 a
1.00	1.70 a	1.65 a	1.67 a	3.04 a	2.95 a	3.00 a	3.30 a	3.44 a	3.37 a
F.test (B X S)			*			NS			NS

Table (30): Effect of boron fertilizers on sodium percentages in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Sodium % in root			Sodium % in petiole			Sodium % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	2.25 a	2.32 a	2.28 a	3.87 a	3.92 a	3.89 a	4.44 a	4.68 a	4.56 a
0.50	2.20 a	2.36 a	2.28 a	4.06 a	4.02 a	4.04 a	4.14 b	4.40 b	4.27 b
1.00	1.93 b	2.11 a	2.02b	3.90 a	4.01 a	3.96 a	3.60 c	3.99 c	3.80 c
F.test (B X S)			NS			NS			NS

Table (31): Effect of boron fertilizers on yield of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	Root yield (ton/fed)			Top yield (ton/fed)			Sugar yield (ton/fed)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	28.24 b	28.45 b	28.35 b	11.17 c	11.40 b	11.28 c	4.73 c	4.77 c	4.75 c
0.50	28.94 a	29.01 a	28.97 a	12.51 b	13.16 a	12.84 b	4.94 b	4.95 b	4.94 b
1.00	29.14 a	29.25 a	29.19 a	13.47 a	13.63 a	13.55 a	5.09 a	5.11 a	5.10 a
F.test (B X S)			NS			NS			NS

* : significant , NS : not significant

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.

Table (32): Effect of molybdenum fertilizers on growth criteria of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Root length (cm)			Root diameter (cm)			Root fresh weight (gm)			Top fresh weight (gm)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Zero	24.77 c	25.06 c	24.91 c	12.44 c	12.75 c	12.60 c	935.2 c	939.1 c	937.1 c	345.7 c	337.5 c	341.6 c
0.25	26.62 b	26.75 b	26.68 b	13.03 b	13.47 b	13.25 b	961.2 b	960.0 b	960.6 b	375.3 b	396.3 b	385.8 b
0.50	28.63 a	28.28 a	28.46 a	13.59 a	14.56 a	14.07 a	986.6 a	991.3 a	988.9 a	419.3 a	439.1 a	429.2 a
F.test (Mo X S)			NS			NS			NS			NS

Table (33): Effect of molybdenum fertilizers on juice quality percentages of sugar beet roots at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Total soluble solids %			Sucrose %			Purity %		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	24.61 a	24.08 a	24.34 a	16.31 c	16.41 c	16.36 c	66.38 c	68.22 c	67.30 c
0.25	24.33 b	23.71 b	24.02 b	17.26 b	17.22 b	17.24 b	71.07 b	72.80 b	71.93 b
0.50	23.77 c	23.27 c	23.52 c	17.90 a	17.81 a	17.85 a	75.55 a	76.71 a	76.13 a
F.test (Mo X S)			NS			NS			NS

* : significant , NS : not significant

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

Table (34): Effect of molybdenum fertilizers on boron concentrations (ppm) in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Boron (ppm) in root			Boron (ppm) in petiole			Boron (ppm) in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	12.14 b	11.69 c	11.92 c	29.41 b	28.55 b	28.98 a	29.13 c	29.82 b	29.48 b
0.25	12.75 ab	12.49 b	12.62 b	29.49 b	28.91 a	29.20 a	29.88 b	29.82 b	29.73 b
0.50	13.39 a	13.36 a	13.38 a	29.83 a	28.92 a	29.37 a	30.96 a	30.32 a	30.64 a
F.test (Mo X S)			NS			NS			*

Table (35): Effect of molybdenum fertilizers on molybdenum concentrations (ppm) in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Molybdenum (ppm) in root			Molybdenum (ppm) in petiole			Molybdenum (ppm) in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	4.14 c	3.95 b	4.05 c	4.22 c	4.63 c	4.42 c	4.89 c	5.08 b	4.98 c
0.25	4.44 b	4.28 b	4.36 b	4.76 b	5.04 b	4.90 b	5.09 b	5.19 b	5.14 b
0.50	4.69 a	4.68 a	4.68 a	5.26 a	5.55 a	5.40 a	5.29 a	5.58 a	5.44 a
F.test (Mo X S)			NS			NS			NS

Table (36): Effect of molybdenum fertilizers on nitrogen percentages in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Nitrogen % in root			Nitrogen % in petiole			Nitrogen % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
Zero	1.75 a	1.47 a	1.61 a	2.61 a	2.58 a	2.59 a	3.66 a	3.70 a	3.68 a
0.25	1.54 b	1.32 b	1.43 b	2.42 b	2.42 b	2.42 b	3.46 b	3.55 b	3.50 b
0.50	1.39 c	1.22 c	1.31 c	2.25 c	2.21 c	2.23 c	3.30 c	3.41 c	3.35 c
F.test (Mo X S)			NS			NS			NS

* : significant , NS : not significant

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

Table (37): Effect of molybdenum fertilizers on potassium percentages in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Potassium % in root			Potassium % in petiole			Potassium % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	1.93 a	1.76 a	1.84 a	3.33 a	2.84 a	3.09 a	3.46 a	3.44 a	3.45 a
0.25	1.77 b	1.51 b	1.64 b	3.09 b	3.07 a	3.08 a	3.26 ab	3.23 a	3.24 a
0.50	1.52 c	1.34 c	1.43 c	2.79 c	2.63 a	2.71 b	3.09 b	3.28 a	3.18 b
F.test (Mo X S)			NS			NS			NS

Table (38): Effect of molybdenum fertilizers on sodium percentages in the different plant organs of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Sodium % in root			Sodium % in petiole			Sodium % in blade		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	2.25 a	2.32 a	2.28 a	3.87 a	3.92 a	3.89 a	4.44 a	4.68 a	4.56 a
0.25	2.20 a	2.36 a	2.28 a	4.06 a	4.02 a	4.04 a	4.14 b	4.40 b	4.27 b
0.50	1.93 b	2.11 a	2.02b	3.90 a	4.01 a	3.96 a	3.60 c	3.99 c	3.80 c
F.test (Mo X S)			NS			NS			NS

Table (39): Effect of molybdenum fertilizers on yield of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Molybdenum levels (kgMo/fed)	Root yield (ton/fed)			Top yield (ton/fed)			Sugar yield (ton/fed)		
	2002/03	2003/04	combined	2002/03	2003/04	combined	2002/03	2003/04	combined
zero	27.88 c	28.17 c	28.03 c	11.35 c	11.12 c	11.24c	4.52 c	4.61 c	4.56 c
0.25	28.84 b	28.80 b	28.82 b	12.25 b	12.89 b	12.57 b	4.96 b	4.94 b	4.95 b
0.50	29.60 a	29.74 a	29.67 a	13.55 a	14.17 a	13.86 a	5.28 a	5.28 a	5.28 a
F.test (Mo X S)			NS			NS			NS

* : significant , NS : not significant

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

Table (40): Effect of interaction between varieties and boron fertilizer on boron concentration (ppm) in blade of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	Zero	0.50	1.00	zero	0.50	1.00
Montebianco	27.81 e	28.32 e	29.55 cd	27.98 e	28.27 de	29.04 cd	27.90 e	28.29 e	29.30 d
Kawemira	29.13 d	29.92 c	30.86 b	29.18 c	30.04 b	31.00 a	29.16 d	29.98 c	30.93 b
Gloria	31.10 b	30.68 b	32.56 a	31.17 a	30.80 ab	31.67 a	31.13 b	30.74 b	32.11 a
F.test (V X B X S)	-			-			NS		

Table (41): Effect of interaction between varieties and boron fertilizer on molybdenum concentration (ppm) in petiole of some sugar beet varieties at harvest (2002/03, 2003/04 seasons and their combined).

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	zero	0.50	1.00	zero	0.50	1.00
Montebianco	4.49 de	5.01 ab	4.68 cd	5.07abcd	4.84 cd	4.89 bcd	4.78 bc	4.92 ab	4.78 bc
Kawemira	4.94 abc	4.84 bc	4.65 cd	5.37 a	5.33 ab	5.26 abc	5.15 a	5.08 a	4.95 ab
Gloria	4.65 cd	5.13 a	4.33 e	4.66 d	5.14 abc	5.10 abcd	4.65 c	5.14 a	4.71 bc
F.test (V X B X S)	-			-			*		

* : significant , NS : not significant

Table (42): Effect of interaction between varieties and boron fertilizer on molybdenum concentration in blade (ppm) of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	zero	0.50	1.00	zero	0.50	1.00
Montebianco	5.32 a	5.23 a	5.08 a	5.43 ab	5.20 ab	5.12 ab	5.37 ab	5.22abcd	5.10 bcd
Kawemira	5.03 a	5.32 a	5.03 a	5.31 ab	5.57 a	5.06 b	5.17abcd	5.44 a	5.05 cd
Gloria	4.70 b	5.02 a	5.07 a	5.24 ab	5.16 ab	5.47 ab	4.97 d	5.09 cd	5.27 abc
F.test (V X B X S)	-			-			NS		

Table (43): Effect of interaction between varieties and boron fertilizer on nitrogen percentage in petiole of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	zero	0.50	1.00	zero	0.50	1.00
Montebianco	2.23 c	2.37 bc	2.26 c	2.52 ab	2.38 abc	2.44 ab	2.38 b	2.37 b	2.35 b
Kawemira	2.30 bc	2.47 ab	2.35 bc	2.43 ab	2.53 ab	2.33 abc	2.36 b	2.50 ab	2.34 b
Gloria	2.66 a	2.60 a	2.61 a	2.29 bc	2.16 c	2.55 a	2.47 ab	2.38 b	2.58 a
F.test (V X B X S)	-			-			NS		

* : significant , NS : not significant

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

Table (44): Effect of interaction between varieties and boron fertilizer on nitrogen percentage in blade of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Boron level (kg B/fed)			Boron level (kg B/fed)			Boron level (kg B/fed)		
	zero	0.50	1.00	zero	0.50	1.00	zero	0.50	1.00
Montebianco	3.40 bc	3.66 a	3.55 ab	3.62 ab	3.46 b	3.96 a	3.51 ab	3.56 a	3.62 a
Kawemira	3.38 bc	3.25 c	3.53 ab	3.43 b	3.46 b	3.62 ab	3.41 bc	3.35 c	3.57 a
Gloria	3.55 ab	3.48 ab	3.46 b	3.15 ab	3.63 ab	3.56 ab	3.53 ab	3.56 a	3.51 ab
F.test (V X B X S)	-			-			*		

Table (45): Effect of interaction between varieties and molybdenum fertilizer on root length (cm) of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)		
	zero	0.25	0.50	zero	0.25	0.50	zero	0.25	0.50
Montebianco	25.63 cd	28.22 b	30.96 a	26.07 de	28.26 bc	30.15 a	25.85 d	28.24 b	30.56 a
Kawemira	25.04 d	26.70 c	28.96 b	25.44 e	27.15 cd	28.74 b	25.24 de	26.93 c	28.85 b
Gloria	23.63 e	24.93 d	25.96 cd	23.67 f	24.85 ef	25.96 de	23.65 f	24.89 e	25.96 d
F.test (V X Mo X S)	-			-			NS		

* : significant , NS : not significant

Table (46): Effect of interaction between varieties and molybdenum fertilizer on total soluble solids percentage of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)		
	zero	0.25	0.50	zero	0.25	0.50	zero	0.25	0.50
Montebianco	24.95 a	24.62 ab	24.31 bc	24.24 a	24.01 ab	23.71 b	24.59 a	24.32 b	24.01 c
Kawemira	24.56 b	24.30 bc	23.79 d	24.05 ab	23.86 b	23.22 c	24.30 b	24.08 bc	23.50 d
Gloria	24.32 bc	24.06 cd	23.22 e	23.95 ab	23.25 c	22.88 d	24.14 bc	23.65 d	23.05 e
F.test (V X Mo X S)	-			-			NS		

Table (47): Effect of interaction between varieties and molybdenum fertilizer on potassium percentage in root of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)		
	zero	0.25	0.50	Zero	0.25	0.50	zero	0.25	0.50
Montebianco	2.31 a	2.12 ab	1.62 de	2.19 a	1.85 b	1.49 c	2.25 a	1.98 b	1.55 d
Kawemira	1.93 bc	1.81 cd	1.65 de	1.56 c	1.32 cd	1.33 cd	1.75 c	1.57 d	1.49 de
Gloria	1.55 ef	1.38 fg	1.28 g	1.51 c	1.36 cd	1.20 d	1.53 de	1.37 ef	1.24 f
F.test (V X MoX S)	-			-			NS		

* : significant , NS : not significant

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

Table (48): Effect of interaction between varieties and molybdenum fertilizer on sodium percentage in root of some sugar beet varieties at harvest (2002/03, 2003/04 seasons (S) and their combined)

Variety (V)	2002/03			2003/04			combined		
	Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)		
	zero	0.25	0.50	zero	0.25	0.50	zero	0.25	0.50
Montebianco	2.39 a	2.28 ab	2.03 bc	2.58 a	2.31 abc	2.03 abc	2.48 a	2.30 abc	2.03 cd
Kawemira	2.43 a	2.52 a	1.91 c	2.41 abc	2.22 abc	2.01 bc	2.42 a	2.37 ab	1.96 d
Gloria	1.94 bc	1.79 c	1.87 c	1.97 c	2.56 ab	2.30 abc	1.95 d	2.17abcd	2.08 bcd
F.test (V X MoX S)	-			-			NS		

Table (49): Effect of interaction between boron and molybdenum fertilizers on total soluble solids percentage of sugar beet roots at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	2002/03			2003/04			combined		
	Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)			Molybdenum level (kg Mo/fed)		
	zero	0.25	0.50	zero	0.25	0.50	zero	0.25	0.50
zero	24.90 a	24.64 ab	24.31 bc	24.38 a	24.00 b	23.86 bc	24.64 a	24.32 b	24.08 bc
0.50	24.55 ab	24.34 b	23.51 d	23.95 b	23.53 d	22.93 e	24.25 b	23.94 cd	23.22 e
1.00	24.37 b	23.98 c	23.49 d	23.89 bc	23.57 cd	23.00 e	24.13 bc	23.78 d	23.24 e
F.test (B X Mo X S)	-			-			NS		

* : significant , NS : not significant

Table (50): Effect of interaction between boron and molybdenum fertilizers on sodium percentage in blade of sugar beet at harvest (2002/03, 2003/04 seasons (S) and their combined)

Boron levels (kg B/fed)	2002/03 Molybdenum level (kg Mo/fed)		
	zero	0.25	0.50
zero	4.53 a	4.28 ab	3.91 c
0.50	4.40 ab	4.06 bc	3.35 d
1.00	4.38 ab	4.06 bc	3.54 d
F. test (B X Mo X S)	-		
Boron levels (kg B/fed)	**2003/04 Molybdenum level (kg Mo/fed)**		
	zero	0.25	0.50
zero	2.20 cd	2.30 bc	2.06 de
0.50	2.28 bc	2.23 cd	2.37 abc
1.00	2.47 ab	2.56 a	1.91 e
F. test (B X Mo X S)	-		
Boron levels (kg B/fed)	**combined Molybdenum level (kg Mo/fed)**		
	zero	0.25	0.50
zero	4.58 a	4.31 bc	4.04 de
0.50	4.56 a	4.23 cd	3.55 f
1.00	4.53 ab	4.26 cd	3.81 e
F. test (B X Mo X S)	NS		

* : significant , NS : not significant

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.

Table (51): Effect of interaction between varieties, boron and molybdenum fertilizers on total soluble solids percentage of sugar beet roots at harvest (2002/03, 2003/04 seasons (S) and their combined)

Varieties (V)	Boron levels (kg B/fed)	2002/03			2003/04			combined		
		Molybdenum levels (kg Mo/fed)			Molybdenum levels (kg Mo/fed)			Molybdenum levels (kg Mo/fed)		
		zero	0.25	0.50	zero	0.25	0.50	zero	0.25	0.50
Montebianco	zero	25.13 a	25.02 ab	24.76 abcd	24.77 a	24.35 ab	23.91 bc	24.95 a	24.68 ab	24.34 bcde
	0.50	24.78 abcd	24.63 abcde	24.18 Defg	24.12 bc	23.81 bc	23.73 bc	24.45 bcd	24.22 cde	23.96 efg
	1.00	24.93 abc	24.20 defg	23.99 efghi	23.80 bc	23.86 bc	23.46 cd	24.36 bcde	24.03 defg	23.72 fgh
Kawemira	zero	24.91 abc	24.33 bcdef	24.64 abcde	24.36 ab	23.83 bc	23.92 bc	24.63 abc	24.08 defg	24.28 bcde
	0.50	24.47 abcdef	24.38 bcdef	23.33 ij	23.79 bc	23.83 bc	22.92 de	24.13 def	24.11 def	23.12 jk
	1.00	24.28 cdef	24.17 defg	23.38 hij	23.99 bc	23.91 bc	22.81 e	24.14 def	24.04 defg	23.09 jk
Gloria	zero	24.65 abcde	24.57 abcdef	23.51 ghij	24.02 bc	23.82 bc	23.77 bc	24.34 bcde	24.20 cdef	23.64 ghi
	0.50	24.41 bcdef	24.02 efgh	23.02 j	23.95 bc	22.96 de	22.15 f	24.18 cdef	23.49 hij	22.59 L
	1.00	23.90 fghi	23.58 ghij	23.10 j	22.87 bc	22.95 de	22.72 e	23.89 efgh	23.27 ijk	22.91 kL
F. test (VX B X Mo X S)		-			-			NS		

* : significant , NS : not significant

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

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

SUMMARY

SUMMARY

Two field experiments were conducted in Sakha Research Station Kafr El-Sheikh Agricultural Research Center during 2002/2003 and 2003/2004 seasons to investigate the effect of boron and molybdenum fertilizer levels on yield and quality of some sugar beet varieties.

This study included 27 treatments which were the combination between three sugar beet varieties (Montebianco, Kawemira and Gloria), three boron fertilizer levels (zero, 0.50 and 1.00 kg B/fed) and three levels of molybdenum fertilizer (zero, 0.25 and 0.50 kg Mo/fed).

Treatments were arranged in a split plot design with three replications. Varieties were allocated the main plots and the combination between levels of boron and molybdenum were assigned at random within sub-plots. Plot area was 17.5 m^2 consists of five ridges 7 m in length and 2.5 m in width and the space between ridges 50 cm and between hills 20 cm.
Results could be summarized as follows:

I. Growth measurements:

a. Effect of seasons:

1. Results pointed out that root diameter as well as leaves fresh weight/ plant were insignificantly affected by the growing seasons.

2. Root fresh weight/ plant showed significantly response to the growing season at 120 and 150 days from sowing.
3. Total soluble solids (TSS %) were significantly affected by the growing seasons. Sucrose percentage, significantly affected at 120 days from sowing only. Juice purity percentage, significantly affected by growing season at 120 days from sowing as well as 180 days from sowing.

b. Varietal performance:

1. Root dimensions and root fresh weight/plant were significantly affected by the three studied varieties at the three sampling dates, except top fresh weight at 120 and 150 days from sowing. Montebianco variety gave the highest values of the studied traits followed by Kawemira, while Gloria variety gave the lowest ones.
2. Total soluble solids, sucrose and purity percentages were significantly affected by varieties at the three growth stages. Montebianco variety recorded the highest values of total soluble solids, however, it gave the lowest values of sucrose and purity percentages. On the other hand, variety Gloria gave the lowest values of total soluble solids percentage, meanwhile, it gave the highest values of sucrose and purity percentage at the three growth stages.

c. Effect of the interaction between varieties and seasons:

1. Top fresh weight in the three samples was insignificant.
2. Root length, diameter in the third stage and root fresh weight in the first and second stages were significant.

3. Total soluble solids, sucrose and purity percentages were insignificantly affected by this interaction at the three stages.

d. Effect of boron fertilizer levels:

1. Root dimensions were significantly increased as the boron level increased from 0.50 to 1.00 kg B/fed in the combined for the different growth stages.
2. Root fresh weight/plant was significantly increased in first and second seasons at the three samples with increasing boron level up to 1 kg B/fed except at 150 days in second season was insignificant.
3. Top fresh weight/plant was insignificantly affected by boron level in the first and the second seasons and their combined at 120 and 150 days from sowing, however it was increased significantly by increasing boron up to 1.00 kg B/fed at 180 days from sowing.
4. Total soluble solids percentage was significantly affected by boron fertilizer levels in the various growth stages in both seasons and their combined.
5. Sucrose and purity percentages increased statistically by increasing boron at all growth stages of the two seasons and their combined, except when the plant aged 120 days.

e. Effect of the interaction between boron fertilizer levels and seasons:

1. Root dimensions, root and top fresh weight/plant were insignificantly affected by this interaction, except at 120 days from sowing.

2. Sucrose and purity percentages were significantly affected by this interaction at 120 days from sowing.

f. Effect of molybdenum fertilizer levels:

1. The highest values of root dimensions were attained by adding 0.50 kg Mo/fed.
2. Root fresh weight/plant of the different growth stages and top fresh weight/ plant at 180 days were significantly increased in the two growing seasons and their combined.
3. The lowest values of TSS% was obtained by applied 0.50 kg Mo/fed. The same level, gave the highest values of sucrose and purity percentages.

g. Effect of the interaction between molybdenum fertilizer levels and seasons:

1. Root dimensions, root and top fresh weight were significant at 150 days from sowing.
2. Juice quality percentages of sugar beet were insignificantly affected in the three growth stages, except total soluble solids percentage was significantly decreased as the applied dose of molybdenum increased at 120 and 180 days from sowing.

h. Effect of the interaction between varieties and boron fertilizer levels:

1. Root fresh weight at 120 days as well as top fresh weight/plant at 120 and 150 days from sowing was significantly affected.
2. Application of 1.00 kg B/fed to Montebianco variety gave the highest value of root fresh weight, while applied of 0.50 kg

B/fed with Gloria variety gave the lowest value at 120 days from sowing.

3. Application of 1.00 kg B/fed to Kawemira variety gave the highest value of top fresh weight/plant, while the same level with Montebianco variety gave the lowest value in the first and second stages.

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

1. Root fresh weight was significant at 120 days from sowing.
2. Top fresh weight was insignificant in the first and second growth stages.

II. Harvest studies:

a. Effect of seasons:

1. Growth criteria in terms of root length, root diameter and root and top fresh weight/ plant appeared insignificant influence by the growing seasons.
2. Total soluble solids and purity percentages were significantly affected by the growing seasons whereas sucrose percentage was not affected.
3. Micro (boron and molybdenum) and macro (nitrogen and potassium) contents of root, petiole and blade were not affected by the growing season, except the values of nitrogen percentage in roots and sodium percentage in blade.
4. Root, sugar and top yield of sugar beet crop were insignificantly affected by the growing seasons.

b. Varietal performance:

1. Montebianco variety recorded the highest root dimensions as well as root and top fresh weight/plant followed by Kawemira and Gloria.
2. Total soluble solids, sucrose and purity percentages were significantly differed in both seasons and their combined. Montebianco variety attained the highest value of total soluble solids percentage, while, Gloria variety produced the highest values of sucrose and purity percentages.
3. Variety Gloria recorded the highest boron concentration in root, petiole and blade in the single season and/or the combined of the two seasons.
4. Molybdenum concentrations of roots, petioles and blades of the studied varieties were insignificantly affected by the examined varieties.
5. Nitrogen percentages of the studied varieties did not reach the level of significance, except the first season for roots and petioles.
6. Montebianco variety gave the highest values of potassium concentration followed by Kawemira and Gloria variety.
7. Sodium concentration of roots was significantly differed in the first season and their combined over the two seasons.
8. Montebianco variety had the greatest root and top yields. While, Gloria variety gave the highest values of sugar yield in the two seasons and their combined.

c. Effect of the interaction between varieties and seasons:

Root diameter, nitrogen in root and petiole and sodium in root concentrations were significantly affected by this interaction.

d. Effect of boron fertilizer levels:

1. Increasing boron supply from zero (control) to 0.50 and 1.00 kg 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.
2. Applied 1.00 kg B/fed significantly increased root fresh weight/plant of the two seasons amounted to 3.08 and 0.77 % corresponding 22.22 and 6.10 % for top fresh weight/plant compared with control or application of 0.50 kg B/fed, respectively in the combined.
3. Increasing the supplied dose of boron negatively affected the values of TSS %. However, increasing the applied dose of boron caused a significant increase in sucrose and purity percentages.
4. Boron contents in root, petiole and blade varied significantly and increased as the applied dose of boron fertilizer increased up to 1.00 kg B/fed in both seasons and their combined.
5. Application of 1.00 kg B/fed attained a significant increase in the molybdenum concentration in roots in the two seasons and their combined. However application of 0.50 kg B/fed gave the highest insignificant concentration of molybdenum in the petiole and blade.
6. Nitrogen concentrations in roots, petioles and blades were insignificantly affected by the different boron fertilizer levels

in the two seasons and their combined, except blades in the combined.

7. Potassium content in roots responded significantly to the applied boron fertilizer levels in the second season, except petioles and blades in both seasons and their combined.
8. Sodium percentage content in blades was significantly affected by the applied levels of boron in the combined of the two seasons except in roots and petioles.
9. Root yield/fed was insignificantly responded to the applied levels of boron in both seasons and their combined.
10. Application of 0.50 kg B/fed attained additional increment in sugar yield over control treatment amounted by 4.43 %, 3.77 % and 4.00 % while, 7.61 %, 7.13 % and 7.37 % with 1.00 kg B/fed in both seasons and their combined, respectively.
11. Application of boron levels significantly increased top yield in the two seasons and their combined amounted by 13.83 % and 20.12 % over control by increasing level of boron to 0.50 and 1.00 kg B/fed.

e. Effect of the interaction between boron fertilizer levels and seasons:

This interaction was significantly affected on root diameter, boron and molybdenum concentrations in root and petiole and potassium content in root.

f. Effect of molybdenum fertilizer levels:

1. Root length, diameter, root and top fresh weight/plant were gradually increased as molybdenum levels increased from zero

to 0.25 up to 0.50 kg Mo/fed in the two seasons and their combined.

2. Application of 0.50 kg Mo/fed gave the tallest and thicknest roots, root and top fresh weight.
3. Sucrose and purity percentages were significantly increased with increasing molybdenum levels. On the contrary, total soluble solids percentage negatively responded to application.
4. Increased molybdenum fertilizers up to 0.50 kg Mo/fed significantly affected roots, petioles and blades in the two seasons and their combined except boron content in petioles in their combined. Application of 0.50 kg Mo/fed gave the highest value of boron contents in root, petiole and blade.
5. Increased molybdenum fertilizers up to 0.50 kg Mo/fed significantly affected molybdenum contents in roots, petioles and blades in the two seasons and their combined.
6. Increasing the applied dose of molybdenum decreased nitrogen percentages in roots, petioles and blades.
7. Potassium concentrations in root, petiole and blade were significantly influenced by molybdenum treatment in the first season and the combined, except petiole and blade in the second season.
8. Sodium concentrations in root and blade were significantly affected by molybdenum fertilizer in the combined, except petiole.
9. Increasing molybdenum up to 0.25 and 0.50 kg Mo/fed significantly increased root yield/fed in both seasons and their combined. The increases in root yield over the control by applying 0.25 kg Mo/fed amounted to 3.44 %, 2.24 % and 2.82%, while it reached 6.17 %, 5.57 % and 5.85 % when

molybdenum level increased to 0.50 kg Mo/fed in the first, second seasons and their combined, respectively.

10. Sugar yield/fed had significantly responded to molybdenum application in the two seasons and their combined. Application of 0.25 kg Mo/fed increased sugar yield over control amounted to 9.73 %, 7.16 % and 8.55% and to 16.81 %, 14.53 % and 15.79 % at 0.50 kg Mo/fed in the first and second seasons and their combined, respectively.
11. Application of 0.25 and 0.50 kg Mo/fed significantly increased of top yield/fed in the combined over the two seasons; the increment amounted to 11.82 % and 23.30 % over control, respectively.

g. Effect of the interaction between molybdenum fertilizer levels and seasons:

Concerning the interaction between molybdenum fertilizer levels and seasons, it was insignificant effects on all traits, except boron content on blade.

h. Effect of the interaction between varieties and boron fertilizer levels:

1. The interaction had significant effects on boron and nitrogen contents in blade and molybdenum concentration in petiole and blade.
2. The highest values of boron content and nitrogen percentage in blade were obtained with 1.00 kg B/fed for varieties Gloria and Kawemira, respectively.
3. Fertilizing variety Kawemira with 0.50 kg B/fed gave the highest values of molybdenum concentration in blade.

4. Variety Kawemira with 0.50 and 1.00 kg B/fed gave the lowest nitrogen percentages in petiole and blade, respectively.

i. Effect of the interaction between varieties, boron levels and seasons:

The interaction between varieties, boron levels and seasons, had significant effects on all traits, except both boron and molybdenum concentrations in blade.

j. Effect of the interaction between varieties and molybdenum fertilizer levels:

1. The interaction applied had a significant effects on root length, total soluble solids percentage, potassium and sodium percentages in sugar beet roots.
2. Application 0.50 kg Mo/fed with variety Montebianco recorded the highest value of root length.
3. Variety Gloria gave the lowest values of total soluble solids and potassium percentages with 0.50 kg Mo/fed.

k. Effect of the interaction between varieties, molybdenum fertilizer levels and seasons:

The interactions were insignificantly affected on total soluble solids, potassium, sodium percentages and root length.

l. Effect of the interaction between boron and molybdenum fertilizers:

1. Total soluble solids percentage recorded the lowest percentage by applying fertilizers mix (0.50 kg B/fed + 0.50 kg Mo/fed)

compared with control in the second growing season and the combined.

2. Sodium percentage in blade was significantly influenced by applying boron and molybdenum fertilizer levels. The lowest percentage was obtained by applying 0.50 kg B/fed and with 0.50 kg Mo/fed in the first season and the combined.

m. Effect of the interaction between boron and molybdenum fertilizers and seasons:

The interaction boron and molybdenum fertilizers and seasons had insignificant effects on sodium percentage in blade.

n. Effect of the interaction between varieties, boron and molybdenum:

1. Results revealed that the values of total soluble solids percentage were statistically affected between boron, molybdenum fertilizers and varieties.
2. The highest values of total soluble solids percentage were recorded for the unfertilized treatment.

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

This interaction between varieties, boron and molybdenum and seasons, had insignificant effects on total soluble solids percentage (Tables, 51).

LITERATURE CITED

LITERATURE CITED

Abd-Alla (1992). Studies on some factors affecting the productivity of sugar beet. M.Sc. Thesis. Fac. of Agric. El-Minufiya Univ.

Abd El-Aal, S.M. and H.A. Dawwam (1991). Evaluation of some imported sugar beet varieties in Minufiya Governorate. Minufiya, J. Agric. Res. **16** (1): 137-149.

Abd El-Ghaffar, F.M.; T.M. Fayed and A.H. Nour (1981). Effect of harvesting date on yield and quality of some sugar beet varieties. Agric. Res. Rev. Cairo, **59** (8): 1-14.

Abd El-Fatah, E.F. (2000). Factors affecting yield of some sugar beet varieties in newly reclaimed soil. M.Sc. Thesis. Fac. of agric., Cairo Univ.

Abd El-Hady, A.H. Hammam (1969). The effect of boron on sugar beet. M. Sc. Thesis Fac. Agric. Ain Shams Univ.

Abo El-Ghait, R. (1993). Evaluation of some sugar beet varieties under different environmental conditions. M.Sc. Thesis Fac. of Agric El Minufiya Univ. Egypt.

Ali, S. A. M. (2005). Agricultural studies on sugar beet in newly reclaimed lands of Sohag Governorate. M. Sc. Thesis, Fac. of Agric. Minia Univ.

Al-Labbody, A.H. (2003). Evaluation of some multigerm and monogerm sugar beet varieties under Fayoum Governorate conditions. Ph.D. Thesis. Fac. of Agric. Al-Azhar Univ. Egypt.

AL-Saad, F.A.; M.M. Habib and M.A. Bacha (1984). Evaluation of sugar beet varieties grown in the central region, Saudi Arabia. Journal of the College of Agric., King Saud Univ. **6**: 27-36. (C. F. 260 of 393 CAB Abst., 1987-1989).

Anikeev, A.S.; G.I. Bershak and Z.D. Pronina (1978). Effect of trace elements on root yields, sugar content and technological qualities of sugar beet roots. Refractivny Zhurnal 6. 55. 474. (C. F. Field crop Abst., **32** (3): 1755).

Antoniv, S.F. (1981). Nutrient uptake by sugar beet and its yield in relation to fertilizer application in a rotation. Agrokhimiya **8**: 39-46. (C. F. Soils and Fert. Abst., **46** (9): 1983).

Association of Official Agricultural Chemist (1995). Official methods of analysis published by the A.O.A.C., Box 540, Washington.

Attia, A.N. and M.S. Sultan (1987). Response of some sugar beet varieties to irrigation intervals and harvesting dates. Conf. of Agric. Sci., Mansoura. Egypt, 22nd June, 1987.

Badawi, M.A. (1985). Studies on sugar beet. Ph.D. Thesis, Fac. of Agric., Mansoura Univ.

Baginskas, B. (1963). Effect of trace elements on yield and quality of sugar beet. Gonot. Agr. (4): 618-628. (C.F. Chem. Abst., bb (7) 1967.

Bedrinets, V.K.; I.T. Pershak and V.I. Gudim (1975). Effect of superphosphate enriched with trace elements on yield of sugar beet. Naukova dumka., 60-62. (C. F. Field crop Abst., **29** (4): 3026).

Besheit, S.Y. and A.A. El-Gharabawy (1991). Cultivars, harvesting dates and their effect on yield and quality of sugar beet. Ann. of Agric. Sci. Moshtohor **29** (2): 717-728.

Besheit, S.Y.; Shehata M. Mona and El-Maghraby S. Samia (1994). The use of nitrogen for sugar beet grown in sandy soil of Egypt. Egypt. J. Appl. Sci., **9** (12): 225-231.

Bogdevich, I.M.; R.V. Shtalova and S.A. Tivota (2000). Yield and quality of sugar beet in relation to nitrogen fertilizer rates and acidity of a Sod- podzolic Light loamy soil. Pochvovedenie- I- Agrokhimiya 1998, 30: 3-13

Bondok, M. A. (1996). The role of boron in regulation growth, yield and hormonal balance in sugar beet (*Beta vulgaris*). Annals of Agric., Sci. Cairo; **41** (1): 15–33.

Brown, I.D. and O. Lilliland (1964). Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry. Proc. Amer. Soc. Hort. Sci., 48, 341-346.

Brysov, N. S., (1974). Effect of microelements on growth development sugar beet. Botanika Isledovaiya, **9** (13): 124-130. C. F. Field Crop Abst., **25** (2): 2220,1972.

Campbell, L.G. and J.J. Kern (1982). Cultivars x environment interaction in sugar beet yield trials. Crop Sci., **22**: 932-935.

Carruthers, A., and J. F. T. Oldfield (1961). Methods for the assessment of beet quality. Int. Sug. J., 63 (1): 103- 105.

Castelo-Branco, M.A.; M.G. Serrao; M.L. Fernandes; E.M. Sequeira; H. Domingues; F.P. Pires; M.A.C. Fragoso and M.L. van Beusichem (1993). Foliar diagnosis of sugar beet: mineral composition of leaves of different physiological age during the season. Optimization of plant nutrition: refereed papers from the Eighth International Colloquim for the Optimization of plant Nutition, 31 Aug. 8 Sep. 1992, Libson, Portugal. 137-146; Developments in Plant and Soil Sci **53**. (C.F. Record 32 of 62 - CAB Abst., 1993-1994).

Cermin, L.S. Zak. and A. Michalikova (1988). Efficiency of selected sugar beet varieties. Pol'nohospodarstvo. **34** (11): 978-986. (C. F. Field Crop Abst., **42** (9): 7230).

Chelombitko, V. G., (1970). Effect of boron on physiological and biochemical processes in leaves of sugar beet and its productivity. Sb. Nauch. Trud. Gdena. Sel. Kboz. Inst. (RU) C.F. Field Crop Abst., **24** (4): 697. 1971.

Czuba, R. (1994). The results of foliar nutrition of field crops. II. Response of plants to foliar application of trace elements or nitrogen combined with trace elements. Roczniki Gleboznawcze. **45**: 3-4, 79-87. (C. F. Record 9 of 422 - CAB Abst., 1995).

Domska, D. (1996). Yield and quality of sugar beet after foliar feeding with nitrogen, magnesium, boron and copper. Polish J. Food and Nut. Sci. **5**: 2, 23-31.

Dragan, I.; I. Rusu; L. Bireescu; I. Peia and D. Sampaleanu (1987). Reclamation of a gleyed solonetz from Timisoara Agronomic Institute by cropping with sugarbeet on a drained, limed and fertilized soil. Lucrari Stiintifice Inst. Agro. Timisoara Agro. **22**: 9-13. (C.F. Record 81 of 166 - CAB Abst., 1987-1989).

Duncan, D. B. (1955). Multiple ranges and multiple F. test Biometrics, 11: 1- 24.

El-Geddawy, I.H.M.; Laila, M. Saif and F.A. Abd El- Latief (2001). Hoeing and nitrogen fertilization with respect to quality yield components of some sugar beet varieties grown in upper Egypt. J. Agric. Sci. Mansoura Univ., **26** (8): 4607-4621.

El-Kobbia, T.; H. Hamdi and A. Abd El-Hady (1971). Effect of boron fertilizationon yield of sugar beet grown in calcareous soils. U.A.R.J. of soil Sci. **11** (1): 53-59.

El-Mashhadi; H.H.M. (1988). The effect of some micro elements on the nutrition of sugar beet. Ph.D. Thesis. Fac. of Agric Ain Shams Univ.

EL-Taweel, Fayza, M.A. (1999). Response of some sugar beet varieties to potassium and magnesiun fertilizers. Ph.D. Thesis. Fac. of Agric. Moshtohr, Zagazig Univ., (Banha Branch).

Enan, S.A.A.M. (2004) Egypt of transplanting and soil application of boron and zinc on yield and quality of sugar beet. Ph.D. Thesis, Fac. of agric. Al Azhar, Univ. Cairo.

Eweida, M.H.T., A.M. Hassanien, A.M. Hagras and A.F. El-Magraby (1984). Effect of some growth regulators and microelements on tield and some chemical constituents in sugar beet. The 2nd Conf., Agric. Res. C enter, Giza. 9-11.

Genaidy, S.A. (1988). Role of potassium, boron and zinc fertilization on yield and quality of sugar beet grown on Northern Delta Soils. Alex. Sci. Exch., **9** (1): 25-34.

Gezgin, S.; B. Sade; M. Hamurcu; N. Dursun; M. Onder and M. Babaoglu (2000). Effect of various Boron, Zinc and N P K levels on the yield and sugar content of sugar beet (*Beta vulgaris saccharifera*). Proceeding of the international work shop Boron, 2001. University Bonn, Bonn Germany. 23–28 June. 2001.

Ghura, Nabawia, S. (1989). Studies on Sugar beet. M.Sc.Thesis. Fac. of Agric., Alex.Univ. Egypt.

Gomez, K. A. and A. A. Gomez (1984). Statistical Procedures For Agricultural Research. A Wiley- Inter- Science Publication, John Wiley and Sons, New York.

Gritsenko, V.V.; B.P. Shaldaev; L.N. Zakharov and M.I. Pavlov (1985). A method of increasing the quality of sugar beet seeds. Sakharnaya Svekla **4**: 26-27. (C. F. Field Crop Abst., **40** (6): 3812).

Hanna, A.S.; A.T. El-Kassaby; A.N. Attia and M.A. Badawi (1988). Studies on the inter relationship among planting dates, hill spacing, varieties and nitrogen fertilization in sugar beet. J. Agric. Sci., Monsoura Univ., **13** (2): 598-605.

Hanousek, J. (1973). The results of experiments with the application of trace elements to sugar beet in 1970-72. Agrochemia **13** (5): 1142- 1145. (C. F. Field Crop Abst., **27** (1): 1974).

Hassanein, M.A. (1991). Yield response of some sugar beet varieties to thinning and harvesting dates. Bull. Fac. of Agric., Cairo Univ., **42** (3): 673 686.

Hassanein, M.A. and A. Abuldahab (1991). Effect of foliar fertilization with some micronutrents on the yield and quality of sugar beet (Beta vulgaris L.). Bulletin of faculty of Agric., University of Cairo. 42: 3, 663-672.

Havashida, M.; Y. Oda, Y. Sugii and A. Tanaka (2001). Characteristics of a new sugar beet vatiety "Abend". Society of sugar Techno. 1999, No 41, 16-24. 2 Ref.

Ibrahim, M.F.M. (1998). The effect of some fertilization elements on the yield and quality of sugar beet. Ph.D. Thesis, Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

Ibrahim, M.H.; S.G.H.R. Sorour and A.M. Omar (1988). Varietal response of sugar beet to foliar application of some microelements. Proc. 3rd Egyptian Conf. Agron. Kafr El- Sheikh, 5-7 Sept. 1988. Vol. **11**: 324-334.

Jackson, K.l. (1956). Soil chemical analysis advanced course (4th printing, 1968). Published by the auther. Soil Sci., Dept. Wisconsin Univ., USA.

Jassem, M. (1982). Characters and value of sugar beet varieties cultivated in Poland. Gazeta Cukr. **89:** 14-16. (C. F. Plant Breed. Abst., **53** (2): 1502).

Jaszczolt, E. (1998). Influence of two methods of fertilizing sugarbeet with trace elements on the yields of roots and sugar. Gazeta-Cukrownicza. **106**: 12, 232-234. (C.F. Record 11 of 166 - CAB Abst., 1998/08-2000/07).

Kajiyama, T.; T. Arito and M. Tezuke (2000). A new sugar beet variety Floden. Bull. of Hokkaido Prefectural Agric. Exp. Sta., **75**: 53-57.

Kalimeri, E. and X. Pellumbi (1982). The effect of zinc, boron and copper trace elements on yield and quality of sugar beet. Buletinin Shkencove Buiqesore **20** (3): 53-62. (C.F. field Crop Abst., **36** (11): 690, 1983.

Karamvandi, A and M.J. Malakouti (1998). A study on the effects of potassium, sulfur and boron on quality and quantity of sugar beet in Karaj. Soil and Water. J. **12**: 6, 49-54, 105.

Karvatskii, V.A. (1975). Effect of fertilizers containing trace elements on yield and quality of sugar beet. Referactivnyi Zhurnal, **5**, 55, 709. (C. F. Field crop Abst., **38** (1): 342).

Kimber, D.S. and S.F.H. McCullagh (1986). Trails of commercial varietes of sugar beet. Brit. Sugar beet. Rev. **54** (2): 20-25.

Krunic, D., M. Pantovic and Z. Papovic (1980). The effect of tracc elements on the yield and quality of sugar beet on chermozen, brown forst, black swamp and alluvium soils. Agrochemical (9-10) 345-383. (C.F. Field Crop Abst. **34** (7): 5747).

Kudryashov, V. S. (1985). Application of boron to sugar beet. Sakharaya Svekla (7): 38-39. (c.f. Field Crop Abst., 40(5): (1987).

Kupper, K. and K. Herzog (1988). Greater effectiveness of beet production by extending thc sugar beet variety list. Feldwirtschaft. **29** (12): 553-554. (C. F. Field Crop Abst., **43** (7): 5163).

Ksenz, L. and I. Putskaya (1983). Foliar spry of sugar beet with major and trace elements. Khiniya and Vysoil. Rastenyia, **21** (1): 21-22. C. F. Field Crop Abst. **36**: 12, 1069, 1983.

Kurbel, V. O. (1976). Application of production function in an economic analysis of application of boron fertilizer to sugar beet. Savremena Poljoprivreda, **24** (718): 39-50 C. F. soil and fertilizer, **43** (10): 952, 1980.

Lashkevich, G.I. (1980). Effect of fertilizer and trace elements fertilizer treatments on wheat, barley, sugar beet and [Potato production quality]. Biyal. Navuk **3**: 59-60.

Le Docte, A. (1927). Commercial determination of sugar beet root using the Sacks Le-Docte Process. Int. Sugar J. **29:** 488-492.

Leilah, A.A. and S.M. Nasr (1992). The contribution sowing and harvesting dates on yield and quality of some sugar beet cultivars. Conf. Agron., Zagazig, 13-15 Sept., **2**: 970-979.

Li, G.Q; Z.W. Shi, G.F. Li, L.J. Yang and M.Z. Gui (1993). Studies on nutrient deficient symptoms of sugar beet at seedling stage. China-Sugarbeet. 2: 1-6. (C.F. Record 355 of 364 - CAB Abst., 1995)

Ljubic, J. (1980). Effect of some trace elements on the growth and yield of sugar beet and maize.Agrochemija(1/20):1-5.

Mahmoud, E. A.; M. A. El-Metwally and M. E. M. Gohar (1999). Yield and quality of some multigerm sugar beet as affected by plant densities and nitrogen levels. J. Agric. Sci. Mansoura Univ., **24** (9): 4499-4516.

Mazepin, K.G. and N.N. Nikitaeva (1977). Effect of trace elements on yield and quality of sugar beet. Sakhara, **1:** 49-53. (C. F. Field Crop Abst., **32** (8): 5511).

Meirmanov, M. and K. Nuralin (1977). Effect of molybdenum on yield of sugar beet. Referactivnyi Zhurnal., 8. (C. F. Field Crop Abst., **31** (3): 1981).

Milford, G.f.J. and J. Riley (1980). The effects of temperature on leaf growth of sugar beet varieties. Ann. of Appl. Bio. **94**: 431-443.
(C. F. Plant Breed. Abst., **51** (5): 4416).

Mohamed, K.E. (1993). Physiological studies on sugar beet (Beta vulgaris L.). M.Sc. Thesis, Fac. of Agric. Al-Azhar Univ.

Mokadem, S.A. (1993). Evaluation of some sugar beet varieties with varying plant poplation under Minia Governorate conditions. Ph.D. Thesis. Agron. Dep. Fac. of Agric. Minia Univ. Egypt.

Morsy, M.A. and E.M. Taha (1986). Effect of B, Mn and their combination on sugar beet under El-minia condition. 2- concentration and uptake of N, P, K, B and Mn. Ann. Agric. Sci. Ain Shams Univ. **31** (2): 1241-1259.

Moustafa, R. Zeinab (1989). Effect of some microelements on some biochemicals constituents in sugar beet plant. M.Sc. Thesis Soil Sci. Dept. Fac. Agric. Ain Shams Univ.

Nafei, A. I. (2004). Effect of nitrogen and boron fertilization levels on yield and quality of sugar beet grown in Upper Egypt.Egypt. J. Appl. Sci; Vol. 19 No.2 February 2004. **11**: 48–57.

Nassar, M.A.A. (1992). Effect of harvest time on the productivity of some sugar beet varieties. M.Sc. Thesis, Agric. Fac., Cairo Univ. Egypt.

Nemeat Alla. E. A. E. (1997). Agronomic studies on sugar beet. Ph.D. Thesis, Agron Dep. Agric. Fac., Kafr El-Sheikh Tanta Univ.

Obead, E.K. (1988). Effects of varieties, rate and time of nitrogen fertilization on growth, yield and quality of sugar beet. Ph.D. Thesis, Fac. of Agric., Cairo Univ., Egypt.

Omelchenko, L.A. (1975). Increasing the productivity of sugar beet by persowing enrichment of seeds with trace elements. Referactivnyi Zhurnal., **6**: 55, 685. (C. F. Field Crop Abst., **29** (2): 1148).

Omelchenko, L.A. and G.A. Rusakov (1973). Effect of trace elements on some biochemical processes of sugar beet.

Nauchnye Trudy Voro. Inst. **8** (5): 94-100. (C. F. Field crop Abst., **28** (8): 4746,1975).

Osman, A.M.H. (1997). Effect of some micronutrients on yield and quality of sugar beet (*Beta vulgaris,* L.). M.Sc. Thesis, Fac. of Agric. Zagazig Univ.

Osman, A.M.H.; G.S. El-Sayed and A.I. Nafei (2004). Effect of foliar application date of B and bioconstituents (Yeast Extraction) on yield and quality of sugar beet. Egypt. J. Appl. Sci.; **19** (2) 2004 pp 76-98.

Osman, A.M.H.; G.S. El-Sayed; M.S.H. Osman and K.S. El-Sogheir (2003). Soil application of some microelements with relation to yield and quality of sugar beet varieties. Ann. of Agric. Sci., Moshtohor, Zagazig Univ. **41** (3): 1135-1152.

Pergl, F. (1945). Quantitative Organic Micro Analysis 4th Ed. J. and Churchill LTD., London.

Perveen, S.; N. Wajahat; S. Muzammil; W. Nazif and M. Shah (2000). Effect of potassium with and without boron on chemical composition of sugar beet at Peshawar. Sarhad. J. Agric. 2000, **16**: 2, 189-192.

Ramadan, B.S.H. (1999). Differential response of sugar beet varieties to plant density and harvesting dates. J. Agric. Sci. Mansoura Univ., **24** (2): 413-423.

Ramadan, B.S.H. and M.A. Hassanin (1999). Effect of sowing dates on yield and quality of some sugar beet varieties. J. Agric. Sci. Mansoura Univ., **24** (7): 3227-3237.

Saif, Laila .M. (1991). Yield and quality of sugar beet as affected by nitrogen sources and rate of some microelements in Kafr El-sheikh. Ph.D. Thesis,Fac. of Agric. Ain Shams Univ.

Saif, Laila. M. (2000). Stepwise regression and path coefficient analysis for some sugar beet characters under levels of boron and nitrogen fertilization.Proc. 9th Conf. Agronomy., Minufiya Univ., 1–2 Sept. 2000: 569–581.

Saita, H; K. Kurosawa and M. Yamakami (1994). Studies on analysis of growth Patternsin sugar beet. Lodifferences ingrowth patterns between varieties. Nippon beet Manufacturing Company LTd obihiro 080 Japan. (C. F. 114 of 150 CAB Abst., 1995).

Sako, K.; S. Takada and T. Yoshida (1982). The process of maturation in varieties of sugar beet which differ in yield and sugar characters. 2. Noxious components. Proc. of the Sugar Beet Res. Assoc. **24**: 18-24. (C. F. 23 of 140 CAB Abst., 1984).

Schwarzbach, E.; J. Hartmann and V. Srba (1996). Results of 1993-1995 join variety trials of the Association of sugar beet. Grows of Czech lands, Agricultural Monitoring and

Testing Institute, Prague Sugar beet Research Institute and Semcice Sugar beet Institute. Listy Cukrovarnicke a Reparske., **112** (3): 72-74. (C.F. Field Crop Abst., **50** (4): 1997).

Shahin, M.A. (1986). Effect of boron and Gibberalic acid on sugar beet plants. M.Sc. Thesis. Fac. of Agric. Al-Azhar Univ.

Shaker, A. T. and A. Al-Roami, (1989). Effect of different concentration of boron and manganese on growth of sugar beet. Mesoptamia Jour. Of Agric., **21** (2): 277-287. C. F. Field Crop Abst. **42** (10).1989.

Shalaby, N.M. (1998). Effect of different nitrogen levels and the period of no irrigation before harvesting on yield and quality of sugar beet. M.Sc. Thesis Fac. of Agric., AL-Azhar Univ.

Shalaby, N.M. (2003). Effect of enviromental conditions on the behaviour of different genotypes of sugar beet root yield and quality. Ph.D. Thesis Fac. of Agric., AL-Azhar Univ.

Snedecor, G.V. and W.G. Cochran (1967). Statistical methods 6 th Ed Iowa Stat Univ. Press, Amess, Iowa, USA.

Sperlingsson, C. and S. Larsson (1997). Sugar beet variety trials. Betodlaren. 1: 20-22. (C.F. Field Crop Abst., **50** (10): 5410).

Sroller, J. (1978). The effect of trace elements fertilization on the chemical composition of beet seedling. Agronomicka, A. (2): 255-264. (c.f. Field Crop Abst., **34** (1): 403, 1981).

Stratieva, S.; B. Sedlaraka and D. Sioyanov (1990). Effect of Zn and B on sugar beet grown on aleached smontiza chemozem soil. Pochvoznainie Agrokhimiya, **25** (1) 9-14. (soil and fertilizers **55** (3): 2544).

Sviridov, A.S. (1975). Dependence of yield and quality of sugar beet on rates of boron and manganese on leached chernozem soil. Nouchnye Trudy, Vorone Zhshii Sel Slokhozayai Stvennyi Institut (72): 65-68. (C. F. Field Crop Abst., **29** (4): 59058,1978).

Tadorcic, B. and A. Faller (1977). Boron fertilization of sugar beets. Zemljiste Biljka, **26** (1): 55-70. (C. F. Chem Abst., **89** (6): 59058, 1978).

Taha, E.M.; El-Ashmony and A.A. El-Sherbeny (1985). The influence of sowing dates and varieties on yield of sugar beet. Minia J. Agric. Res. And Rev. (2): 737-748.

Tariq, M.; K.J. khattak and G. Sarvar (1993). Effect of B on the yield and quality of sugar beet in Peshawar valley. Dept. Soil Sci., NWEP. Agric. Univ., Peshawar, PAK. Sci. Khyber **6** (2): 97-106.

Toma, S.I.; S.S. Lisnik; S.G. Veliksar and M.V. Kaush (1991). Regulation of adaptive reactions and plant productivity by means of trace elements. Bull. Acad. de Stiine a Rep. Moldova. Stiintte Biologice Si Chimice. **4:** 3-11. (C. F. Record 28 of 62 - CAB Abst.1992).

Tripathi, B.K.; D. Singh and G.P. Misra (1986). Breeding sugar beet for short duration cropping on subtropical regions of India. India. J. Sugar Beet Technol. (3): 84-87.

Vlasyuk, P.A.; D.I. Lavientovich and L.M. Chernova (1974). Effect of manganese on photosynthesis, carbohydrate metabolism and yield of sugar beet Referativnyi Zhurnal **8**. 55-587 (C.F. Field Crop Abst. **28** (6): 3150).

Voth, R.D.; J. Reisen and D.R. Chirstenon (1979). Effect of applied boron on yield of sugar beet. Res. Rep., Agric. Exper, Sta. Michigan State Univ. No.376, 4 pp. (C. F. Soils and Fert., **43** (10): 837,1980).

Wang, K.R. (1994). Reasons for low germination rate of monogerm sugar beet seed and preliminary approach on measures for improving seed germination. China Sugar Beet (**2**): 16-19. North East Agricultural Univ., Harkin, Heilongziang 150030. China. (c.f. Field Crop Abst., **48** (9): 6852, 1995).

Witek, A. (1998). Effect of foliar fertilizer application to sugar beet on the amount and quality of the yield. Gazeta Cukrownicza. **106**: 8, 149-151.

Wrobel, S. (1996). Effect of microelements fertilizer application on yield and chemical composition of sugar beet grown without farmyard manure. Zeszyty Problemowe Postepow Nauk Rolniczych. **434**: I, 139-143. (C.F. Record 47 of 62 - CAB Abst., 1996-1998/07).

Wrobel, S. (1997). Effect of micronutrient fertilization on yield and chemical composition of sugar beet. Burak Cukrowy I Pastewny, Bydgoszcz, Poland, 20-22 Sep 1995. Biuletyn Instytutu Hodowli I Aklimatyzacji Roslin. **202:** 193-196. (C.F. Record 40 of 62 - CAB Abst., 1996-1998/07).

Zolotov, L.N. and K.V. Lavrov (1973). Effectiveness of the different methods of application of trace elements to sugar beet. Referativnyi Zhurnal **10**: 540-545. (C. F. field Crop Abst., **27** (6): 2794, 1974).

APPENDIX

Table (1): Mean some square for growth criteria of sugar beet plant at 120 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Root length			Root diameter			Root fresh weight			Top fresh weight		
				Mean Square			Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	8.07	3.03	9.10	8.33*	21.25	22.89	154.0	489.9	591.7	26724.5	2838.6	9761.5
2	Year (Y)	-	1	-	-	6.99	-	-	7.57	-	-	115680.5	-	-	15176.6
-3	Error	-	2	-	-	1.99	-	-	6.68	-	-	52.2	-	-	19801.5
4	Varieties (V)	2	2	36.63*	74.81**	105.56**	40.96**	4.78	25.79	114126.7**	38743.4*	113916.9**	15567.5	6160.9	11960.6
6	Y * V	-	2	-	-	5.88	-	-	19.95	-	-	38953.1**	-	-	9767.8
-7	Error	4	8		0.95	3.06	1.25	11.55	6.40	1433.1	3612.5	2522.8	167727.2	14660.0	91193.6
8	Boron (B)	2	2	32.35**	39.15**	70.14**	18.21**	5.65*	22.07**	24250.3**	4563.5*	6545.0**	8324.3	14382.0	1266.9
10	Y * B	-	2	-	-	1.36	-	-	1.79	-	-	22268.9**	-	-	21349.5
12	V * B	4	4	0.27	0.90	1.04	3.12**	0.40	1.34	1997.4	9610.0**	4889.9**	43585.9**	16784.0	48382.7**
14	Y * V * B	-	4	-	-	0.14	-	-	2.18	-	-	6717.4**	-	-	11987.2
16	Molybdenum(Mo)	2	2	31.30**	68.53**	94.33**	1.91*	18.34**	15.99**	33736.4**	21850.8**	54843.6**	246878.6**	4547.5	158237.7**
18	Y * Mo	-	2	-	-	5.51*	-	-	4.26*	-	-	743.6	-	-	93188.4**
20	V * Mo	4	4	0.20	1.02	0.42	0.46	0.34	0.36	480.8	205.8	459.1	25242.7	11269.1	22448.5
22	Y * V * Mo	-	4	-	-	0.80	-	-	0.43	-	-	227.4	-	-	14063.3
24	B * Mo	4	4	1.72	1.20	1.69	0.21	0.59	0.12	1266.5	728.2	653.0	2283.2	2394.1	1143.9
26	Y * B * Mo	-	4	-	-	1.23	-	-	0.68	-	-	1341.7	-	-	3533.3
28	V * B * Mo	8	8	0.87	1.45	1.93	0.10	0.23	0.08	630.7	2547.2*	1251.3	9699.1	11039.8	10397.4
30	Y*V*B*Mo	-	8	-	-	0.39	-	-	0.24	-	-	1926.6	-	-	10341.6
-31	Error	48	96	0.98	2.00	1.49	0.72	1.56	1.14	1937.7	1189.9	1568.3	12385.8	11518.7	11952.3

*: significant , **: highly significant

Table (2): Mean some square for juice quality percentages of sugar beet plant at 120 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Total soluble solids %			Sucrose %		Purity %	
				Mean Square			Mean Square		Mean Square	
		S	Com.	S1	S2	Com.	S1	S2	S1	S2
1	Replication	2	2	0.54	0.11	0.21	0.27	0.42	39.16	6.54
2	Year (Y)	-	1	-	-	21.42*	-	-	-	-
-3	Error	-	2	-	-	0.44	-	-	-	-
4	Varieties (V)	2	2	3.30*	2.13*	5.17**	45.37*	45.62**	2710.71*	2897.57**
6	Y * V	-	2	-	-	0.27	-	-	-	-
-7	Error	4	8	0.32	0.24	0.28	6.34	0.43	308.64	32.25
8	Boron (B)	2	2	2.40**	3.29**	5.41**	3.06	0.60	332.68**	60.60
10	Y * B	-	2	-	-	0.27	-	-	-	-
12	V * B	4	4	0.07	0.13	0.07	1.97	0.75	83.44	45.01
14	Y * V * B	-	4	-	-	0.13	-	-	-	-
16	Molybdenum(Mo)	2	2	3.00**	11.78**	13.31**	0.71	1.45*	182.37	69.23*
18	Y * Mo	-	2	-	-	1.47**	-	-	-	-
20	V * Mo	4	4	0.10	0.71	0.67	2.00	0.35	87.06	77.25**
22	Y * V * Mo	-	4	-	-	0.14	-	-	-	-
24	B * Mo	4	4	0.11	0.52	0.52	1.10	1.16*	53.34	77.10**
26	Y * B * Mo	-	4	-	-	0.11	-	-	-	-
28	V * B * Mo	8	8	0.42	0.48	0.80	2.54	0.56	133.70	28.62
30	Y*V*B*Mo	-	8	-	-	0.11	-	-	-	-
-31	Error	48	96	0.21	0.37	0.29	1.36	0.40	66.89	21.84

*: significant , **: highly significant

Table (3): Mean some square for growth criteria of sugar beet plant at 150 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Root length			Root diameter			Root fresh weight			Top fresh weight		
				Mean Square			Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	7.14	2.00	7.82	9.63*	25.97	26.49	105.8	782.3	496.6	21170.1	2488.2	8233.9
2	Year (Y)	-	1	-	-	5.78	-	-	5.05	-	-	6792.6*	-	-	19164.4
-3	Error	-	2	-	-	1.32	-	-	9.11	-	-	391.5	-	-	15424.4
4	Varieties (V)	2	2	35.02	73.20**	103.12**	40.74	3.64	22.56	23239.4	12487.2	32088.6	12514.9	7072.4	10149.9
6	Y * V	-	2	-	-	5.10	-	-	21.82	-	-	3638.1*	-	-	9437.4
-7	Error	4	8	6.62	1.23	3.92	0.88	11.49	6.19	3945.1	5796.7	4870.9	145086.2	13037.0	79061.6
8	Boron (B)	2	2	31.68**	35.88**	66.71**	14.08**	4.95*	17.79**	4238.0*	2241.3	6313.7*	13473.9	12886.3	81.8
10	Y * B	-	2	-	-	0.85	-	-	1.23	-	-	165.6	-	-	26278.97
12	V * B	4	4	0.52	1.45	1.84	4.81**	0.82	1.96	1718.8	2941.8	1082.3	40859.5**	16560.0	404493.4**
14	Y * V * B	-	4	-	-	0.13	-	-	3.67**	-	-	3578.3	-	-	16926.1
16	Molybdenum(Mo)	2	2	32.69**	66.41**	94.22**	1.41	18.64**	15.17**	40971.3**	6117.8	28178.4**	208690.0**	3388.9	131745.4**
18	Y * Mo	-	2	-	-	4.88	-	-	4.89**	-	-	18910.7**	-	-	80333.5**
20	V * Mo	4	4	0.45	1.18	0.55	0.45	0.34	0.75	2101.3	747.9	1613.3	32739.2*	10277.1	26254.3
22	Y * V * Mo	-	4	-	-	1.07	-	-	0.04	-	-	1235.9	-	-	16762.1
24	B * Mo	4	4	1.53	0.90	1.31	0.27	0.19	0.05	232.1	2033.0	1219.1	3989.3	1693.9	1814.3
26	Y * B * Mo	-	4	-	-	1.12	-	-	0.41	-	-	1045.9	-	-	3868.9
28	V * B * Mo	8	8	0.66	1.33	1.56	0.13	0.14	0.10	506.9	1002.3	972.3	6882.0	11413.2	9194.2
30	Y*V*B*Mo	-	8	-	-	0.43	-	-	0.18	-	-	536.8	-	-	9101.0
-31	Error	48	96	0.92	2.04	1.48	0.77	1.47	1.12	1262.5	2318.0	1790.2	11885.9	11146.7	11516.3

*: significant , **: highly significant

Table (4): Mean some square for juice quality percentages of sugar beet plant at 150 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Total soluble solids %			Sucrose %			Purity %		
				Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.07	0.20	0.11	0.37	0.99	0.31	17.19	15.68	10.16
2	Year (Y)	-	1	-	-	10.53**	-	-	0.39	-	-	83.89
-3	Error	-	2	-	-	0.16	-	-	1.01	-	-	22.72
4	Varieties (V)	2	2	5.34**	1.28	5.94**	151.69**	129.83**	281.01**	5998.09**	4884.8**	10851.7**
6	Y * V	-	2	-	-	0.69	-	-	0.51	-	-	31.10
-7	Error	4	8	0.12	0.86	0.49	1.48	0.30	0.89	52.24	26.10	39.17
8	Boron (B)	2	2	1.51**	1.83**	2.68**	3.79**	5.50**	9.21**	244.54**	284.92**	515.81**
10	Y * B	-	2	-	-	0.66	-	-	0.08	-	-	13.65
12	V * B	4	4	0.12	0.03	0.04	0.30	0.21	0.32	5.92	13.42	5.12
14	Y * V * B	-	4	-	-	0.10	-	-	0.19	-	-	14.22
16	Molybdenum(Mo)	2	2	3.05**	5.01**	7.92**	15.02**	10.47**	25.15**	818.80	791.5**	1607.83**
18	Y * Mo	-	2	-	-	0.13	-	-	0.34	-	-	2.46
20	V * Mo	4	4	0.32	0.60	0.65	0.26	0.53	0.62	19.09	40.64	49.64
22	Y * V * Mo	-	4	-	-	0.26	-	-	0.17	-	-	10.09
24	B * Mo	4	4	0.10	0.24	0.29	0.18	0.25	0.38	8.95	11.01	19.50
26	Y * B * Mo	-	4	-	-	0.05	-	-	0.05	-	-	0.46
28	V * B * Mo	8	8	0.27	0.36	0.50	0.35	0.19	0.19	15.68	10.20	15.91
30	Y*V*B*Mo	-	8	-	-	0.13	-	-	0.34	-	-	9.98
-31	Error	48	96	0.26	0.29	0.27	0.83	0.81	0.82	32.52	32.74	34.13

*: significant , **: highly significant

Table (5): Mean some square for growth criteria of sugar beet plant at 180 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Root length			Root diameter			Root fresh weight			Top fresh weight		
				Mean Square			Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	10.71	2.83	11.24	9.19**	25.19	24.87	409.9	25.2	318.9	279.9	28.4	243.1
2	Year (Y)	-	1	-	-	41.14*	-	-	35.95	-	-	10.3	-	-	4.1
-3	Error	-	2	-	-	2.13	-	-	9.52	-	-	116.1	-	-	65.2
4	Varieties (V)	2	2	37.00	75.98*	108.34**	39.56**	4.62	23.13*	28847.2**	2311.8**	51797.9**	28551.1**	23024.3**	5143.0**
6	Y * V	-	2	-	-	2.64	-	-	21.05*	-	-	161.1	-	-	152.5
-7	Error	4	8	4.89	0.78	2.83	0.42	9.75	5.09	464.1	1711.2	1178.6	640.3	1725.5	1182.9
8	Boron (B)	2	2	37.11**	37.50**	73.63**	17.37**	4.92*	20.40**	7101.3**	3120.6	9778.9**	7026.1**	3176.0	9763.0**
10	Y * B	-	2	-	-	0.97	-	-	1.90	-	-	443.0	-	-	439.1
12	V * B	4	4	1.86	1.64	3.25	3.49**	0.39	1.56	405.1	921.9	249.8	375.1	917.4	295.8
14	Y * V * B	-	4	-	-	0.25	-	-	2.31	-	-	1077.2	-	-	996.7
16	Molybdenum(Mo)	2	2	33.40**	173.92**	179.59**	3.46**	50.540**	40.13**	19260.4**	23024.0**	42171.1**	18858.6**	23113.4**	41839.0**
18	Y * Mo	-	2	-	-	27.73	-	-	13.86**	-	-	113.3	-	-	133.0
20	V * Mo	4	4	0.83	1.27	0.84	0.39	0.55	0.46	357.8	699.0	1205.0	520.2	682.0	1048.4
22	Y * V * Mo	-	4	-	-	1.26	-	-	0.47	-	-	144.2	-	-	153.8
24	B * Mo	4	4	1.09	0.52	0.91	0.29	0.66	0.19	357.8	802.4	706.3	295.8	775.8	611.8
26	Y * B * Mo	-	4	-	-	0.70	-	-	0.75	-	-	453.9	-	-	459.9
28	V * B * Mo	8	8	0.47	1.74	1.71	0.10	0.12	0.15	176.5	723.7	437.1	187.0	706.2	459.3
30	Y*V*B*Mo	-	8	-	-	0.51	-	-	0.07	-	-	463.1	-	-	433.9
-31	Error	48	96	0.88	1.97	1.43	0.70	1.52	1.11	770.4	1061.0	915.7	798.0	1066.5	932.3

*: significant , **: highly significant

Table (6): Mean some square for juice quality percentages of sugar beet plant at 180 days from sowing (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Total soluble solids %			Sucrose %			Purity %		
				Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.43	0.07	0.10	0.12	1.11	0.91	14.35	16.13	20.17
2	Year (Y)	-	1	-	-	55.35**	-	-	0.01	-	-	765.17**
-3	Error	-	2	-	-	0.39	-	-	0.33	-	-	10.30
4	Varieties (V)	2	2	2.55*	1.72*	4.20**	156.6**	126.44**	282.24**	4121.14**	3698.85**	7814.12**
6	Y * V	-	2	-	-	0.07	-	-	0.80	-	-	5.87
-7	Error	4	8	0.38	0.19	0.29	1.46	0.67	1.07	43.32	19.01	31.17
8	Boron (B)	2	2	2.02**	2.11**	3.79**	3.81**	5.95**	9.63**	189.15**	249.67**	433.73**
10	Y * B	-	2	-	-	0.34	-	-	0.12	-	-	5.08
12	V * B	4	4	0.26	0.05	0.20	0.28	0.10	0.21	3.68	2.93	1.43
14	Y * V * B	-	4	-	-	0.12	-	-	0.16	-	-	5.17
16	Molybdenum(Mo)	2	2	3.61**	25.76**	24.27**	20.07**	12.23**	31.82**	769.23**	1327.37**	2054.00**
18	Y * Mo	-	2	-	-	5.10**	-	-	0.48	-	-	42.61
20	V * Mo	4	4	0.32	0.17	0.39	0.34	0.30	0.59	19.73	11.36	29.91
22	Y * V * Mo	-	4	-	-	0.10	-	-	0.04	-	-	1.18
24	B * Mo	4	4	0.11	0.19	0.22	0.26	0.28	0.37	7.12	7.27	9.49
26	Y * B * Mo	-	4	-	-	0.08	-	-	0.18	-	-	4.90
28	V * B * Mo	8	8	0.44	0.37	0.74	0.19	0.06	0.15	7.80	8.85	13.92
30	Y*V*B*Mo	-	8	-	-	0.07	-	-	0.10	-	-	2.73
-31	Error	48	96	0.26	0.35	0.31	0.72	0.80	0.76	18.29	20.80	23.54

*: significant , **: highly significant

Table (7): Mean square for growth criteria of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Root length			Root diameter			Root fresh weight			Top fresh weight		
				Mean Square			Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	2.01	1.99	2.87	6.86	24.50	19.98	439.9	567.2	759.7	11906.8	4719.4	14447.6
2	Year (Y)	-	1	-	-	0.03	-	-	13.34	-	-	249.3	-	-	4765.7
-3	Error	-	2	-	-	1.14	-	-	11.38	-	-	247.2	-	-	2178.6
4	Varieties (V)	2	2	8.061**	78.42**	158.67**	62.15**	4.32	33.96*	28967.9**	29357.5**	58317.2**	41121.5*	79736.6**	115968.8**
6	Y * V	-	2	-	-	0.36	-	-	32.52*	-	-	8.22	-	-	488.2
-7	Error	4	8	2.06	0.67	1.36	1.52	11.92	6.72	518.0	385.5	451.8	5435.1	992.6	3213.9
8	Boron (B)	2	2	32.61**	37.69**	68.74**	27.37**	4.76*	27.44**	7480.3**	5059.3**	12388.4**	41235.1**	41668.94--	81821.2**
10	Y * B	-	2	-	-	1.56	-	-	4.70**	-	-	151.3	-	-	1083.0
12	V * B	4	4	1.13	1.13	1.86	1.00*	0.18	0.49	483.9	142.7	215.2	2067.6	1125.9	2855.1
14	Y * V * B	-	4	-	-	0.40	-	-	0.69	-	-	411.5	-	-	338.4
16	Molybdenum(Mo)	2	2	100.82**	70.15**	169.47**	8.84**	22.27**	29.47**	17847.9**	18620.1**	36326.3**	37117.5**	70331.3**	103771.3**
18	Y * Mo	-	2	-	-	1.50	-	-	1.64	-	-	141.7	-	-	3677.5
20	V * Mo	4	4	5.20*	1.80	6.51**	0.14	0.10	0.19	649.1	891.8	1480.1	922.5	1226.6	891.1
22	Y * V * Mo	-	4	-	-	0.49	-	-	0.04	-	-	60.8	-	-	1258.0
24	B * Mo	4	4	0.63	0.94	0.53	0.06	0.26	0.08	414.2	153.1	380.9	1215.5	1130.5	1227.0
26	Y * B * Mo	-	4	-	-	1.04	-	-	0.24	-	-	186.4	-	-	1118.9
28	V * B * Mo	8	8	1.02	1.08	1.58	0.10	0.12	0.10	157.6	139.2	151.8	540.6	1668.6	1635.1
30	Y*V*B*Mo	-	8	-	-	0.52	-	-	0.12	-	-	145.1	-	-	574.1
-31	Error	48	96	1.72	1.61	1.66	0.40	0.14	0.93	761.2	589.9	675.5	983.7	2172.6	1578.2

*: significant , **: highly significant

Table (8): Mean square for juice quality percentages of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Total soluble solids %			Sucrose %		Purity %	
				Mean Square			Mean Square		Mean Square	
		S	Com.	S1	S2	Com.	S1	S2	S1	S2
1	Replication	2	2	0.23	0.01	0.11	0.30	1.09	10.68	17.50
2	Year (Y)	-	1	-	-	12.36**	-	-	-	-
-3	Error	-	2	-	-	0.12	-	-	-	-
4	Varieties (V)	2	2	3.90**	2.64**	6.46**	135.13**	132.51**	2913.31**	2891.69**
6	Y * V	-	2	-	-	0.08	-	-	-	-
-7	Error	4	8	0.07	0.12	0.09	1.35	0.46	31.22	9.15
8	Boron (B)	2	2	3.19**	3.27**	6.32**	3.80**	3.09**	172.87**	153.00**
10	Y * B	-	2	-	-	0.14	-	-	-	-
12	V * B	4	4	0.02	0.13	0.05	0.32	0.11	5.01	1.95
14	Y * V * B	-	4	-	-	0.10	-	-	-	-
16	Molybdenum(Mo)	2	2	4.89**	4.43**	9.27**	17.36**	13.35**	568.04**	488.03**
18	Y * Mo	-	2	-	-	0.05	-	-	-	-
20	V * Mo	4	4	0.20	0.28*	0.33*	0.05	0.34	6.19	3.56
22	Y * V * Mo	-	4	-	-	0.15	-	-	-	-
24	B * Mo	4	4	0.18	0.21	0.35*	0.14	0.38	3.64	8.69
26	Y * B * Mo	-	4	-	-	0.04	-	-	-	-
28	V * B * Mo	8	8	0.21	0.33**	0.35**	0.15	0.05	6.87	5.79
30	Y*V*B*Mo	-	8	-	-	0.19	-	-	-	-
-31	Error	48	96	0.13	0.11	0.12	0.70	0.62	14.70	13.08

*: significant , **: highly significant

Table (9): Mean square for yield and its component of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Root yield (ton/fed) Mean Square			Top yield (ton/fed) Mean Square			Sugar yield (ton/fed) Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.14	0.51	0.35	11.87	4.24	13.93	0.01	0.14	0.13
2	Year (Y)	-	1	-	-	0.71	-	-	4.82	-	-	0.01
-3	Error	-	2	-	-	0.30	-	-	2.19	-	-	0.03
4	Varieties (V)	2	2	31.04**	26.42**	57.11**	36.17*	71.76**	103.70**	5.81**	6.35**	12.15**
6	Y * V	-	2	-	-	0.34	-	-	4.23	-	-	0.01
-7	Error	4	8	0.61	0.34	0.48	5.49	0.89	3.19	0.10	0.08	0.09
8	Boron (B)	2	2	5.99**	4.55**	10.47**	35.96**	37.50**	72.53**	0.90**	0.77**	1.66**
10	Y * B	-	2	-	-	0.07	-	-	0.92	-	-	0.01
12	V * B	4	4	0.48	0.12	0.15	1.97	1.01	2.63	0.04	0.01	0.02
14	Y * V * B	-	4	-	-	0.45	-	-	0.35	-	-	0.03
16	Molybdenum(Mo)	2	2	19.97**	16.75**	36.36**	33.16**	63.29**	93.14**	3.89**	3.05**	6.90**
18	Y * Mo	-	2	-	-	0.36	-	-	3.31	-	-	0.04
20	V * Mo	4	4	0.25	0.80	0.76	0.66	1.10	0.60	0.01	0.06	0.05
22	Y * V * Mo	-	4	-	-	0.29	-	-	1.16	-	-	0.02
24	B * Mo	4	4	0.23	0.13	0.25	1.11	1.01	1.07	0.02	0.06	0.07
26	Y * B * Mo	-	4	-	-	0.11	-	-	1.05	-	-	0.01
28	V * B * Mo	8	8	0.15	0.12	0.11	0.44	1.50	1.43	0.01	0.01	0.01
30	Y*V*B*Mo	-	8	-	-	0.14	-	-	0.52	-	-	0.01
-31	Error	48	96	0.73	0.53	0.63	0.86	1.95	1.41	0.07	0.07	0.07

*: significant , **: highly significant

Table (10): Mean square for boron concentrations (ppm) in the different plant organs of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Boron (ppm) in root			Boron (ppm) in petiole			Boron (ppm) in blade		
				Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.24	0.96	0.23	0.14	5.54**	3.18	0.91	2.11	2.90*
2	Year (Y)	-	1	-	-	2.47	-	-	24.64	-	-	0.30
-3	Error	-	2	-	-	0.98	-	-	2.50	-	-	0.12
4	Varieties (V)	2	2	0.68	2.20	2.26	68.83**	49.44**	111.16**	56.34**	52.66**	108.59**
6	Y * V	-	2	-	-	0.62	-	-	1.10	-	-	0.41
-7	Error	4	8	1.39	1.80	1.59	0.33	0.35	0.34	0.20	2.62	1.41
8	Boron (B)	2	2	53.99**	29.17**	75.50**	24.05**	6.50*	25.96**	20.71**	9.43**	29.03**
10	Y * B	-	2	-	-	7.66**	-	-	4.60**	-	-	1.11
12	V * B	4	4	2.95	2.22	3.48	0.65	4.28*	0.80	0.99	1.24	1.79*
14	Y * V * B	-	4	-	-	1.69	-	-	4.14**	-	-	0.44
16	Molybdenum(Mo)	2	2	10.46**	18.83**	28.68**	1.34**	1.76	2.08	22.80**	3.96**	20.28**
18	Y * Mo	-	2	-	-	0.61	-	-	0.43	-	-	6.47**
20	V * Mo	4	4	1.86	2.20	3.71	1.02**	0.39	1.04	0.32	1.21	1.20
22	Y * V * Mo	-	4	-	-	0.36	-	-	0.37	-	-	0.33
24	B * Mo	4	4	2.57	0.85	1.68	3.18**	1.23	2.05	1.38*	3.40**	1.33
26	Y * B * Mo	-	4	-	-	1.74	-	-	2.36*	-	-	3.45**
28	V * B * Mo	8	8	0.78	0.21	0.54	0.72**	0.57	0.76	0.58	0.81	0.38
30	Y*V*B*Mo	-	8	-	-	0.46	-	-	0.53	-	-	1.01
-31	Error	48	96	1.40	1.92	1.66	0.27	1.68	0.98	0.55	0.79	0.67

*: significant , **: highly significant

Table (11): Mean square for molybdenum concentrations (ppm) in the different plant organs of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Molybdenum (ppm) in root			Molybdenum (ppm) in petiole			Molybdenum (ppm) in blade		
				Mean Square			Mean Square			Mean Square		
		S	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.	
1	Replication	2	2	0.07	0.11	0.13	0.09	0.66	0.30	0.20	0.16	0.05
2	Year (Y)	-	1	-	-	0.61	-	-	4.16	-	-	1.56
-3	Error	-	2	-	-	0.04	-	-	0.45	-	-	.31
4	Varieties (V)	2	2	0.24	0.43	0.31	0.08	1.23	0.95	0.55	0.02	0.23
6	Y * V	-	2	-	-	0.36	-	-	0.35	-	-	0.34
-7	Error	4	8	0.09	0.31	0.20	0.20	0.92	0.56	0.27	0.23	0.52
8	Boron (B)	2	2	6.51**	6.67**	11.73**	1.36**	0.03	0.81**	0.21	0.09	0.17
10	Y * B	-	2	-	-	1.45**	-	-	0.58**	-	-	0.13
12	V * B	4	4	0.67**	0.34	0.46	0.45**	0.37	0.36*	0.25*	0.47*	0.65**
14	Y * V * B	-	4	-	-	0.55	-	-	0.46**	-	-	0.07
16	Molybdenum(Mo)	2	2	2.04**	3.54**	5.46**	7.31**	5.69**	12.92**	1.10**	1.90**	2.87**
18	Y * Mo	-	2	-	-	0.12	-	-	0.07	-	-	0.12
20	V * Mo	4	4	0.08	0.50	0.47	0.09	0.04	0.09	0.11	0.06	0.13
22	Y * V * Mo	-	4	-	-	0.11	-	-	0.04	-	-	0.03
24	B * Mo	4	4	0.06	0.41	0.15	0.07	0.08	0.08	0.15	0.20	0.09
26	Y * B * Mo	-	4	-	-	0.32	-	-	0.08	-	-	0.26
28	V * B * Mo	8	8	0.04	0.05	0.08	0.05	0.04	0.05	0.12	0.14	0.12
30	Y*V*B*Mo	-	8	-	-	0.01	-	-	0.04	-	-	0.14
-31	Error	48	96	0.13	0.39	0.26	0.07	0.18	0.13	0.09	0.19	0.14

*: significant , **: highly significant

Table (12): Mean square for nitrogen percentages in the different plant organs of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Nitrogen % in root			Nitrogen % in petiole			Nitrogen % in blade		
				Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.04	0.01	0.05	0.37	0.07	0.14	0.39	0.65	0.02
2	Year (Y)	-	1	-	-	2.01**	-	-	0.02	-	-	0.25
-3	Error	-	2	-	-	0.01	-	-	0.30	-	-	1.02
4	Varieties (V)	2	2	0.68**	0.01	0.27**	0.80	0.10	0.17	0.16	0.05	0.21
6	Y * V	-	2	-	-	0.42**	-	-	0.73*	-	-	0.01
-7	Error	4	8	0.01	0.03	0.02	0.13	0.17	0.15	0.08	0.13	0.10
8	Boron (B)	2	2	0.03	0.07	0.01	0.05	0.04	0.01	0.03	0.09	0.12*
10	Y * B	-	2	-	-	0.08	-	-	0.10	-	-	0.01
12	V * B	4	4	0.07	0.02	0.02	0.03	0.21**	0.15**	0.15**	0.07	0.09*
14	Y * V * B	-	4	-	-	0.06	-	-	0.10	-	-	0.14**
16	Molybdenum(Mo)	2	2	0.90**	0.43**	1.29**	0.89**	0.92**	1.81**	0.87**	0.58**	1.44**
18	Y * Mo	-	2	-	-	0.04	-	-	0.01	-	-	0.01
20	V * Mo	4	4	0.04	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
22	Y * V * Mo	-	4	-	-	0.04	-	-	0.02	-	-	0.01
24	B * Mo	4	4	0.01	0.01	0.02	0.04	0.01	0.02	0.03	0.01	0.01
26	Y * B * Mo	-	4	-	-	0.01	-	-	0.03	-	-	0.03
28	V * B * Mo	8	8	0.01	0.01	0.01	0.02	0.03	0.02	0.02	0.01	0.02
30	Y*V*B*Mo	-	8	-	-	0.01	-	-	0.02	-	-	0.01
-31	Error	48	96	0.03	0.03	0.03	0.04	0.05	0.05	0.03	0.03	0.03

*: significant , **: highly significant

Table (13): Mean square for potassium percentages in the different plant organs of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Potassium % in root			Potassium % in petiole			Potassium % in blade		
				Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.38	0.37	0.55	0.08	1.03	.86	1.98	0.36	2.01
2	Year (Y)	-	1	-	-	1.66	-	-	2.00	-	-	0.10
-3	Error	-	2	-	-	0.20	-	-	0.25	-	-	0.33
4	Varieties (V)	2	2	2.62*	1.93*	4.13**	1.55**	0.54	1.97**	1.58	0.34	1.68
6	Y * V	-	2	-	-	0.41	-	-	0.13	-	-	0.24
-7	Error	4	8	0.28	0.23	0.25	0.04	0.48	0.26	0.43	0.90	0.66
8	Boron (B)	2	2	0.03	0.34**	0.10	0.01	0.27	0.08	0.08	0.52	0.49
10	Y * B	-	2	-	-	0.27**	-	-	0.21	-	-	0.10
12	V * B	4	4	0.03	0.04	0.01	0.52**	0.74	0.73	0.21	0.32	0.30
14	Y * V * B	-	4	-	-	0.06	-	-	0.53	-	-	0.23
16	Molybdenum(Mo)	2	2	1.18**	1.17**	2.33**	1.97**	1.28	2.46**	0.92**	0.32	1.04*
18	Y * Mo	-	2	-	-	0.03	-	-	0.79	-	-	0.20
20	V * Mo	4	4	0.16**	0.16*	0.30**	0.04	1.17	0.69	0.09	0.19	0.06
22	Y * V * Mo	-	4	-	-	0.02	-	-	0.51	-	-	0.21
24	B * Mo	4	4	0.02	0.12	0.09	0.32**	0.20	0.32	0.05	0.52	0.34
26	Y * B * Mo	-	4	-	-	0.05	-	-	0.20	-	-	0.24
28	V * B * Mo	8	8	0.01	0.03	0.01	0.02	1.32	0.70	0.04	0.31	0.20
30	Y*V*B*Mo	-	8	-	-	0.03	-	-	0.64	-	-	0.15
-31	Error	48	96	0.04	0.06	0.05	0.04	0.91	0.47	0.15	0.31	0.23

*: significant , **: highly significant

Table (14): Mean square for sodium percentages in the different plant organs of sugar beet plant at harvest (2002/03, 2003/04 seasons (S) and their combined)

value	Source	Degree of freedom		Sodium % in root			Sodium % in petiole			Sodium % in blade		
				Mean Square			Mean Square			Mean Square		
		S	Com.	S1	S2	Com.	S1	S2	Com.	S1	S2	Com.
1	Replication	2	2	0.02	1.62*	0.61	0.25	0.05	0.03	0.15	0.10	0.20
2	Year (Y)	-	1	-	-	0.74	-	-	0.07	-	-	3.66**
-3	Error	-	2	-	-	1.03	-	-	0.28	-	-	0.04
4	Varieties (V)	2	2	1.42*	0.06	0.65*	0.36	0.55*	0.90	0.08	0.12	0.01
6	Y * V	-	2	-	-	0.82*	-	-	0.01	-	-	0.20
-7	Error	4	8	0.15	0.14	0.14	0.77	0.05	0.41	0.22	0.11	0.16
8	Boron (B)	2	2	0.10	0.12	0.01	0.06	1.12	0.38	0.70**	0.09	0.51**
10	Y * B	-	2	-	-	0.23	-	-	0.80	-	-	0.28
12	V * B	4	4	0.21	0.26	0.20	0.24	0.84	0.48	0.24	0.31*	0.13
14	Y * V * B	-	4	-	-	0.26	-	-	0.60	-	-	0.42**
16	Molybdenum(Mo)	2	2	0.77**	0.48	1.20	0.28	0.08	0.28	4.84**	3.21**	7.97**
18	Y * Mo	-	2	-	-	0.05	-	-	0.08	-	-	0.09
20	V * Mo	4	4	0.27	0.67*	0.54*	0.21	0.39	0.02	0.06	0.06	0.09
22	Y * V * Mo	-	4	-	-	0.40	-	-	0.58	-	-	0.02
24	B * Mo	4	4	0.11	0.40	0.24	0.65	0.50	0.30	0.12	0.18	0.29*
26	Y * B * Mo	-	4	-	-	0.27	-	-	0.85	-	-	0.01
28	V * B * Mo	8	8	0.05	0.37	0.24	0.23	0.40	0.34	0.07	0.21	0.16
30	Y*V*B*Mo	-	8	-	-	0.19	-	-	0.29	-	-	0.12
-31	Error	48	96	0.12	0.26	0.19	0.40	0.47	0.43	0.12	0.12	0.12

*: significant , **: highly significant

الملخص العربى

"طرز بنجر السكر وبعض العناصر الصغري وعلاقتها بالمحصول والجودة"

أقيمت تجربتان حقليتان بمحطة سخا للبحوث الزراعية بمحافظة كفر الشيخ لدراسة تأثير مستويات التسميد بكلا من البورون والموليبدنيوم علي محصول وجودة بعض أصناف بنجر السكر.

اشتملت الدراسة علي ٢٧ معاملة هي عبارة عن التوافيق بين ٣ أصناف من بنجر السكر (مونت بيانكو، كاوميرا و جلوريا)، ٣ مستويات من البورون (صفر، ٠,٥٠، ١,٠٠ كجم بورون/فدان) و ٣ مستويات من الموليبدنيوم (صفر، ٠,٢٥، ٠,٥٠ كجم موليبدنيوم/فدان) وذلك في تصميم قطع منشقة مرة واحدة ذو ثلاث مكررات حيث وضعت الأصناف في القطع الرئيسية بينما وضعت مستويات البورون والموليبدنيوم في القطع المنشقة، وكانت مساحة القطعة التجريبية ١٧,٥ مترا مربعا اشتملت علي ٥ خطوط بطول ٧ متر والمسافة بين الخطوط ٠,٥٠ متر والمسافة بين الجور ٢٠ سم.

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

أولا: القراءات الدورية:

أ- تأثير السنوات (عند ١٢٠، ١٥٠، ١٨٠ يوما من الزراعة):

١. أوضحت النتائج أنه لا يوجد تأثير معنوي لموسم النمو علي كلا من قطر الجذر والوزن الغض للأوراق/نبات.

٢. كانت هناك استجابة معنوية لموسم النمو علي الوزن الغض للجذر/نبات وذلك عند ١٢٠، ١٥٠ يوما من الزراعة.

٣. كانت هناك استجابة معنوية لموسم النمو وذلك علي النسبة المئوية للمواد الصلبة الذائبة الكلية، كما تأثرت النسبة المئوية للسكروز معنويا عند ١٢٠ يوما من الزراعة فقط، وتأثرت النسبة المئوية للنقاوة معنويا عند ١٢٠، ١٨٠ يوما من الزراعة خلال موسمي الزراعة.

ب- التأثيرات الصنفية:

١. تأثر كل من الطول والقطر والوزن الغض للجذر معنويا بالأصناف المدروسة وذلك في الأعمار الثلاثة للعينات حيث أعطي الصنف مونت بيانكو أعلي قيم للصفات المدروسة يليه الصنف كاوميرا في حين أعطي الصنف جلوريا أقل القيم.

٢. تأثرت كل من النسب المئوية للمواد الصلبة الذائبة الكلية والسكروز والنقاوة معنويا بالأصناف في الأعمار الثلاثة للعينات وأعطي الصنف مونت بيانكو أعلي نسبة مئوية للمواد الصلبة الذائبة الكلية وأقل نسبة مئوية لكل من السكروز والنقاوة، بينما أعطي الصنف جلوريا أقل نسبة مئوية للمواد الصلبة الذائبة الكلية وأعلي نسبة مئوية لكل من السكروز والنقاوة.

ج- تأثير التفاعل بين الأصناف والسنوات:

١. أوضحت النتائج أن الوزن الغض للعرش لم يتأثرا معنويا بهذا التفاعل.

٢. تأثر كلا من طول وقطر الجذر معنويا عند ١٨٠ يوما من الزراعة بينما تأثر الوزن الغض للجذر عند ١٢٠، ١٥٠ يوما من الزراعة.

٣. أوضحت النتائج أن النسب المئوية لكل من المواد الصلبة الذائبة الكلية والسكروز والنقاوة لم تتأثر معنويا بهذا التفاعل وذلك في الأعمار الثلاثة.

د- تأثير مستويات التسميد بالبورون:

١. أوضح التحليل التجميعي لكل عمر من الأعمار الثلاثة أن هناك زيادة معنوية في كلا من طول وقطر الجذر بزيادة مستويات البورون من ٠,٥٠ الي ١,٠٠ كجم بورون/فدان وذلك خلال موسمي الزراعة.
٢. أن هناك زيادة معنوية في الوزن الغض للجذر وذلك عند الأعمار الدورية الثلاثة في كلا الموسمين بزيادة مستوي البورون حتي ١,٠٠ كجم بورون/فدان فيما عدا عمر ١٥٠ يوم من الزراعة في الموسم الثاني.
٣. أشارت النتائج الي أن الوزن الغض للعرش/نبات لم يتأثر معنويا بمستويات البورون في كلا الموسمين وكذلك التحليل التجميعي لكل من العمرين ١٢٠، ١٥٠ يوما من الزراعة في الموسمين، إلا أن هناك زيادة معنوية بزيادة مستويات البورون حتى ١,٠٠ كجم بورون/فدان عند ١٨٠ يوما من الزراعة.

هـ- تأثير التفاعل بين التسميد بالبورون والسنوات:

١. دلت النتائج على أن طول وقطر الجذر والوزن الغض للجذر والعرش لم يتأثر معنويا بهذا التفاعل عدا ١٢٠ يوما من الزراعة.
٢. تأثرت النسبة المئوية لكل من السكروز والنقاوة معنويا بهذا التفاعل عند ١٢٠ يوما من الزراعة.

و- تأثير مستويات التسميد بالموليبدنيوم:

١. أوضحت النتائج أن أعلي قيمة من طول وقطر الجذر أمكن الحصول عليها باضافة مستوي ٠,٥٠ كجم موليبدنيوم/فدان.
٢. كان هناك تأثير معنوي للجذر وذلك في مختلف الأعمار الدورية وكذلك الوزن الغض للعرش عند ١٨٠ يوما من الزراعة في كلا الموسمين والتحليل التجميعي بينهما.

٣. اضافة ٠,٥٠ كجم موليبدنيوم/فدان أعطت أقل نسبة مئوية للمواد الصلبة الذائبة الكلية بينما أعطت أعلي نسبة مئوية للسكروز والنقاوة.

ز – تأثير التفاعل بين مستويات التسميد بالموليبدنيوم والسنوات:

١. كان هناك تأثير معنوي لكل من طول وقطر الجذر وكذلك الوزن الغض للجذر والعرش عند ١٥٠ يوما من الزراعة.

٢. أشارت النتائج إلي أن النسب المئوية لجودة العصير لم تتأثر معنويا خلال الأعمار الثلاثة بينما كان هناك تأثير معنوي للنسبة المئوية للمواد الصلبة الذائبة الكلية حيث انخفضت بزيادة مستويات التسميد بالموليبدنيم عند ١٢٠، ١٨٠ يوما من الزراعة.

ح– تأثير التفاعل بين الأصناف والتسميد بالبورون:

١. تأثر الوزن الغض للجذر معنويا عند ١٢٠ يوما من الزراعة وكذلك كان هناك تأثير معنوي للوزن الغض للعرش/نبات عند ١٢٠، ١٥٠ يوما من الزراعة.

٢. أعطي الصنف مونت بيانكو أعلي وزن غض للجذر بإضافة ١,٠٠ كجم بورون/فدان ، بينما أعطي الصنف جلوريا أقل وزن غض بإضافة ٠,٥٠ كجم بورون/فدان وذلك عند ١٢٠ يوما من الزراعة لكل منهما.

٣. أعطي الصنف كاوميرا أعلي وزن غض للعرش بإضافة ١,٠٠ كجم بورون/فدان ، بينما أعطي الصنف مونت بيانكو أقل قيمة عند نفس المستوي من التسميد وذلك عند ١٢٠ ، ١٥٠ يوما من الزراعة لكل منهما.

ط– تأثير التفاعل بين الأصناف والتسميد بالبورون والسنوات:

١. تأثر الوزن الغض للجذر معنويا بهذا التفاعل عند ١٢٠ يوما من الزراعة.

٢. أظهرت النتائج أن الوزن الغض للعرش لم يتأثر معنويا بهـذا التفاعـل عنـد ١٢٠، ١٥٠ يوما من الزراعة.

ثانيا: قراءات الحصاد:

أ- تأثير السنوات:

أشارت النتائج إلى أن طول وقطر الجذر والوزن الغض للجذر والعرش/نبات لـم تتأثر معنويا باختلاف السنوات وقد:

١. تباينت النسبة المئوية للمواد الصلبة الذائبة الكلية والنقاوة معنويا في الموسـمين بينما لم تتأثر النسبة المئوية للسكروز.

٢. دلت النتائج علي أن محتوي الجذر والعنق والنصل من البورون والموليبـدنيوم والنيتروجين والبوتاسيوم لم يتأثر باختلاف السنوات فيما عدا النـسبة المئويـة للنيتروجين في الجذر و نسبة الصوديوم في النصل.

٣. أشارت النتائج إلي أن محصول الجذر والسكر والعرش لـم يتـأثروا معنويـا باختلاف السنوات.

ب- التأثيرات الصنفية:

١. حقق الصنف مونت بيانكو أعلي طول وقطر للجذر متفوقا علي صنفي كاوميرا وجلوريا كما تأثر الوزن الغض للجذر والعرش/نبات معنويا في كلا الموسمين والتحليل التجميعي لهما.

٢. اختلفت صفات الجودة (النسب المئوية للمواد الصلبة الذائبة الكليـة والـسكروز والنقاوة) معنويا في كلا الموسمين والتحليل التجميعي لهما، وحقـق الـصنف مونت بيانكو أعلي نسبة مئوية للمواد الصلبة الذائبة الكلية بينما حقق الـصنف جلوريا أعلي نسبة من السكروز والنقاوة.

٣. حقق الصنف جلوريا أعلي تركيز لعنصر البورون في الجــذر (فــي الموســم الثاني والتحليل التجميعي) – في حين وجد أعلي تركيز للبــورون فــي عنــق ونصل الأوراق (في الموسمين والتحليل التجميعي لهما).
٤. أوضحت النتائج أن تركيز عنصر الموليبدنيوم في الجــذر والعنــق والنــصل للأصناف المدروسة لم يتأثر معنويا.
٥. أشارت النتائج إلى أن الفروق بين الأصناف في نسبة النيتروجين فــي الجــذر والعنق والنصل لم تصل إلي حد المعنوية في الموسمين والتحليل التجميعي فيما عدا الجذر والعنق في الموسم الأول كانت معنوية.
٦. أعطي الصنف مونت بيانكو أعلي تركيز للبوتاسيوم في الجذر والعنق والنصل يليه صنفي كاوميرا ثم جلوريا.
٧. اختلف تركيز الصوديوم بالجذر معنويا في الموسم الأول والتحليل التجميعي.
٨. تفوق الصنف مونت بيانكو علي باقي الأصناف في محصول الجذور والعــرش بالفدان بينما تفوق الصنف جلوريا في محصول السكر للفدان في كلا الموسمين والتحليل التجميعي.

ج- تأثير التفاعل بين الأصناف والسنوات:

تأثر معنويا كل من قطر الجذر وتركيز النيتروجين في الجذر والعنق وتركيــز الصوديوم في الجذر بالتفاعل بين الأصناف والسنوات.

د- تأثير مستويات التسميد بالبورون:

١. ازداد طول الجذر زيادة معنوية بمقدار ٢,٢٤ ، ٠,٨٩ سم وكذلك قطر الجــذر بمقدار ١,٤٢ ، ٠,٦٩ سم وذلك بزيادة مستويات البورون من صفر إلي ٠,٥٠ الي ١,٠٠ كجم بورون/فدان علي الترنيب.
٢. أدت اضافة البورون بمستوي ١,٠٠ كجم بورون/فدان إلي زيادة معنويــة فــي الوزن الغض للجذر/نبات بمقدار ٣,٠٨، ٠,٧٧ % في كلا الموسمين – بينمــا

أدى عدم إضافة البورون أو إضافته بمستوي ٠,٥٠ كجم بورون/فدان إلي زيادة معنوية في الوزن الغض للعرش/نبات بمقدار ٢٢,٢٢ ، ٦,١٠ % علي الترتيب.

٣. كان لإضافة مستويات أعلي من البورون تأثير سلبي علي نسبة المواد الصلبة الذائبة الكلية ولكنها أدت إلي زيادة معنوية في نسبة السكروز والنقاوة.

٤. كان هناك اختلاف معنوي في محتوي الجذر والعنق والنصل من البورون بزيادة مستويات البورون حتي ١,٠٠ كجم بورون/فدان في كلا الموسمين والتحليل التجميعي.

٥. أدت إضافة ١,٠٠ كجم بورون/فدان إلي زيادة معنوية في تركيز الموليبدنيوم في الجذر في كلا الموسمين والتحليل التجميعي. كما أدت إضافة ٠,٥٠ كجم بورون/فدان إلي تحقيق أعلي تركيز في العنق والنصل والذي لم يصل إلي حد المعنوية.

٦. أوضحت النتائج أن تركيز النيتروجين في الجذر والعنق والنصل لم يتأثر معنويا بمستويات التسميد المختلفة من البورون في كلا الموسمين والتحليل التجميعي بينما تأثر النصل معنويا في التحليل التجميعي.

٧. كان هناك تأثير معنوي لمحتوي الجذر من البوتاسيوم بإضافة مستويات البورون المدروسة في الموسم الثاني علي عكس العنق والنصل في كلا الموسمين والتحليل التجميعي.

٨. تأثر تركيز الصوديوم في النصل معنويا بإضافة مستويات التسميد بالبورون في التحليل التجميعي بينما لم يتأثر معنويا في الجذر والعنق.

٩. استجاب محصول الجذر/فدان معنويا بإضافة مستويات البورون في كلا الموسمين والتحليل التجميعي.

١٠. زاد محصول السكر عن الكنترول بمقدار ٤,٤٣ ، ٣,٧٧، ٤,٠٠ % بإضـافة ٠,٥٠ كجم بورون/فدان بينما ازداد بمقدار ٧,٦١ ، ٧,١٣، ٧,٣٧ % بإضـافة ١,٠٠ كجم بورن/فدان في كلا الموسمين والتحليل التجميعي علي الترتيب.

١١. أدت إضافة مستويات البورون من ٠,٥٠ الي ١,٠٠ كجم بورون/فـدان الـي زيادة معنوية في محصول العرش مقارنة بالكنترول بمقدار ١٣,٨٣ ، ٢٠,١٢ % في كلا الموسمين والتحليل التجميعي.

هـ- تأثير مستويات التسميد بالبورون والسنوات:

وكان هناك تأثير معنوي علي كل من قطـر الجـذر وتركيـزات البـورون والموليبدنيوم في الجذر والعنق وتركيز البوتاسيوم في الجذر بالتفاعل بين التـسميد بالبورون والسنوات.

و- تأثير مستويات التسميد بالموليبدنيوم:

١. كانت هناك زيادة معنوية لكل من طول وقطر ا لجذر والوزن الغـض لا جـذر والعرش/نبات وذلك بزيادة مستويات الموليبدنيوم من صفر إلـي ٠,٥٠ إلـي ١,٠٠ كجم موليبدنيوم/فدان في كلا الموسمين والتحليل التجميعي.

٢. أمكن الحصول علي أعلي طول وسمك للجذر ووزن غض للجـذر والعـرش وذلك بإضافة ٠,٥٠ كجم موليبدنيوم/فدان.

٣. ازدادت نسبتي السكروز والنقاوة معنويا بزيادة مستويات التسميد بالموليبـدنيوم بينما كان لها تأثير سلبي علي نسبة المواد الصلبة الذائبة الكلية.

٤. أدي مستوي التسميد بالموليبدنيوم إلي ٠,٥٠ كجم موليبدنيوم/فدان إلـي زيـادة معنوية في محتوي الجذر والعنق والنصل من البورون فـي كـلا الموسـمين والتحليل التجميعي، عدا محتوي العنق في التحليل التجميعي، كما أعطت نفس الإضافة أعلي قيمة لمحتوي البورون في الجذر والعنق والنصل.

٥. أدت زيادة مستوي التسميد بالموليبدنيوم إلي ٠,٥٠ كجم موليبدنيوم/فدان إلي تأثير معنوي علي محتوي الجذر والعنق والنصل من الموليبدنيوم في كلا الموسمين والتحليل التجميعي.

٦. أدت إضافة مستويات أعلي من الموليبدنيوم إلي نقص نسبة النيتروجين في الجذر والعنق والنصل.

٧. تأثر تركيز البوتاسيوم في الجذر والعنق والنصل معنويا بمستويات الموليبدنيوم في الموسم الأول والتحليل التجميعي بينما لم يتأثر محتوي العنق والنصل في الموسم الثاني.

٨. تأثر تركيز الصوديوم في الجذر والنصل معنويا بمستويات الموليبدنيوم في التحليل التجميعي بينما لم يتأثر محتوي العنق.

٩. أعطي مستوي الموليبدنيوم ٠,٢٥ كجم موليبدنيوم/فدان زيادة معنوية في محصول الجذر/فدان مقارنة بالكنترول بمقدار ٣,٤٤ ، ٢,٢٤، ٢,٨٢ % وأدت اضافة ٠,٥٠كجم موليبدنيوم/فدان الي زيادة قدرها ٦,١٧ ، ٥,٥٧، ٥,٨٥ % في كلا الموسمين والتحليل التجميعي علي الترتيب.

١٠. أعطي مستوي الموليبدنيوم ٠,٢٥ كجم موليبدنيوم/فدان زيادة معنوية في محصول السكر/فدان بالنسبة للكنترول بمقدار ٩,٧٣ ، ٧,١٦، ٨,٥٥ % وأدت اضافة ٠,٥٠كجم موليبدنيوم/فدان الي زيادة قدرها ١٦,٨١ ، ١٤,٥٣، ١٥,٧٩ % في كلا الموسمين والتحليل التجميعي علي الترتيب.

١١. أعطت مستويات الموليبدنيوم ٠,٢٥ ، ٠,٥٠ كجم موليبدنيوم/فدان زيادة معنوية في محصول العرش/فدان عن الكنترول بمقدار ١١,٨٢ ، ٢٣,٣٠% علي الترتيب.

ز- تأثير التفاعل بين مستويات الموليبدنيوم والسنوات:

كما أعطت النتائج أن جميع الصفات لم تتأثر معنويا فيما عدا محتوي النـصل من البورون بالتفاعل بين مستويات الموليبدنيوم والسنوات.

ح- تأثير التفاعل بين الأصناف ومستويات التسميد بالبورون:

وكان هناك تأثير معنوي علي محتوي النـصل مـن البـورون والنيتـروجين ومحتوي العنق والنصل من الموليبدنيوم بالتفاعل بين الأصناف ومستويات التسميد بالبورون وقد:

١- أعطي صنفي جلوريا وكاوميرا أعلي قيمة لمحتوي النـصل مـن البـورون والنيتروجين وذلك باضافة ١,٠٠ كجم بورون/فدان علي الترتيب.

٢- أمكن الحصول علي قيمة لمحتوي النصل من الموليبدنيوم باضافة ٠,٥٠ كجـم بورون/فدان للصنف كاوميرا.

ط- تأثير التفاعل بين الأصناف ومستويات التسميد بالبورون والسنوات:

وتأثرت جميع الصفات المدروسة معنويا بينما لم يتأثر محتـوي النـصل مـن البورون والموليبدنيوم بالتفاعل بين الأصـناف ومـستويات التـسميد بـالبورون والسنوات.

ي- تأثير التفاعل بين الأصناف ومستويات التسميد بالموليبدنيوم:

كما أثر التفاعل بين الأصناف ومستويات التسميد بالموليبدنيوم معنويـا علـي الطول والنسب المئوية للمواد الصلبة الذائبة الكلية والبوتاسيوم والصوديوم الخاصة بالجذر وقد:

١. أدت إضافة ٠,٥٠ كجم موليبدنيوم/فدان للصنف مونت بيانكو إلـي الحـصول علي أعلي طول للجذر.

٢. كانت أقل نسبة مئوية للمواد الصلبة الذائبة الكلية والبوتاسيوم بإضافة ٠,٥٠ كجم موليبدنيوم/فدان للصنف جلوريا.

ك- تأثير التفاعل بين الأصناف ومستويات التسميد بالموليبدنيوم والسنوات:

وأشارت النتائج إلي أن النسبة المئوية للمواد الصلبة الذائبة الكلية والبوتاسيوم والصوديوم وطول الجذر لم تتأثر معنويا بالتفاعل بين الأصناف ومستويات التسميد بالموليبدنيوم والسنوات.

ل- تأثير التفاعل بين التسميد بالبورون والموليبدنيوم:

وتحققت أقل نسبة للمواد الصلبة الذائبة الكلية مع إضافة (٠,٥٠ كجم بورون/فدان + ٠,٥٠ كجم موليبدنيوم/فدان) في الموسم الأول والتحليل التجميعي بينما تحققت أعلي نسبة مئوية للصوديوم في النصل مع عدم التسميد بالبورون والموليبدنيوم (الكنترول).

م- تأثير التفاعل بين التسميد بالبورون والموليبدنيوم والسنوات:

وأشارت النتائج إلي أن النسبة المئوية للصوديوم في النصل لم تتأثر معنويا بالتفاعل بين التسميد بالبورون والموليبدنيوم والسنوات.

ن- تأثير التفاعل بين الأصناف والتسميد بالبورون والموليبدنيوم معا:

١. أشارت النتائج إلي أن النسبة المئوية للمواد الصلبة الذائبة الكلية تأثرت معنويا بالتفاعل بين الأصناف والتسميد بالبورون والموليبدنيوم معا.
٢. وأمكن الحصول علي أعلي نسبة مئوية للمواد الصلبة الذائبة الكلية مقارنة الكنترول.

س- تأثير التفاعل بين الأصناف والتسميد بالبورون والموليبدنيوم والسنوات:

كما أشارت النتائج إلي أن النسبة المئوية للمواد الصلبة الذائبة الكلية لم تتأثر معنويا بالتفاعل بين الأصناف والتسميد بالبورون والموليبدنيوم والسنوات.

طرز بنجر السكر وبعض العناصر الصغري وعلاقتها بالمحصول والجودة

رسالة مقدمة من

باسم صبحي ابراهيم

بكالوريوس العلوم التعاونية الزراعية ١٩٩٢

استكمال شعبة المحاصيل – كلية الزراعة / جامعة بنها ٢٠٠٢

وقد تمت مناقشة الرسالة والموافقة عليها

اللجنة

١- أ.د/ **ألفت حسن الباجوري** ....

أستاذ المحاصيل المتفرغ بكلية الزراعة – جامعة عين شمس.

٢- أ.د/ **علي عبد المقصود الحصري** ....

أستاذ المحاصيل بقسم المحاصيل ووكيل الكلية لشئون التعليم والطلاب بكلية الزراعة – جامعة بنها.

٣- أ.د/ **جمال محمد شمس الدين** ....

أستاذ المحاصيل بقسم المحاصيل بكلية الزراعة – جامعة بنها.

٤- أ.د/ **عدلي محمد مرسي سعد** ....

أستاذ المحاصيل بقسم المحاصيل بكلية الزراعة – جامعة بنها.

٥- أ.د/ **ابراهيم حنفي محمود الجداوي** ....

أستاذ المحاصيل ووكيل معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية.

تاريخ الموافقة / /

طرز بنجر السكر وبعض العناصر الصغري وعلاقتها بالمحصول والجودة

رسالة مقدمة من

باسم صبحي ابراهيم

بكالوريوس العلوم التعاونية الزراعية ١٩٩٢

استكمال شعبة المحاصيل – كلية الزراعة / جامعة بنها ٢٠٠٢

لجنة الإشراف العلمي:

١ – أ.د/ **علي عبد المقصود الحصري**......

أستاذ المحاصيل بقسم المحاصيل ووكيل الكلية لشئون التعليم والطلاب بكلية الزراعة – جامعة بنها.

٢ – أ.د/ **عدلي محمد مرسي سعد** ...

أستاذ المحاصيل بقسم المحاصيل بكلية الزراعة – جامعة بنها.

٣– أ.د/ **ابراهيم حنفي محمود الجداوي** ...

أستاذ المحاصيل ووكيل معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية.

٢٠٠٦

طرز بنجر السكر وبعض العناصر الصغري وعلاقتها بالمحصول والجودة

رسالة مقدمة من

باسم صبحي ابراهيم

للحصول علي درجة

الماجستير في العلوم الزراعية

"محاصيل"

من

قسم المحاصيل والميكنة الزراعية

كلية الزراعة – جامعة بنها

٢٠٠٦