

THE EFFECT OF SOME MACRO- AND MICRO-ELEMENTS ON THE NUTRITION OF SUGAR-BEET

BY

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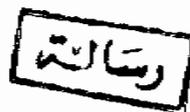
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
وَبِهِ نَسْتَعِينُ

”رَبَّنَا ...

آتِنَا مِنْ لَدُنْكَ رَحْمَةً ...

وَهِيَئَةً لَنَا مِنْ أَمْرِنَا رَشَدًا“

صَدَقَ اللَّهُ الْعَظِيمُ



2

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CONTENTS

	Page
I. INTRODUCTION	1
II. REVIEW OF LITERATURE	3
II.1. The effect of nitrogen fertilization on sugar-beet	3
II.2. The effect of phosphorus fertilization on sugar-beet	8
II.3. The effect of potassium fertilization on sugar-beet	10
II.4. The effect of boron fertilization on sugar- beet	13
II.5. The interaction between certain macro and micro-elements on sugar-beet	16
III. MATERIALS AND METHODS	20
III.1. The effect of nitrogen-boron interaction on sugar-beet	22
III.2. The effect of phosphorus-boron interaction on sugar-beet	23
III.3. The effect of potassium-boron interaction on sugar-beet	25
IV. RESULTS AND DISCUSSION	28
IV.1. The effect of nitrogen-boron interaction on sugar-beet	28
IV.1.1. Fresh weight	28
IV.1.2. Sugar quantity and quality	29
IV.1.3. Dry matter yield, content and uptake of nutrients by sugar- beet tops	34
IV.1.4. Dry matter yield, content and uptake of nutrients by sugar-beet roots	42
IV.2. The effect of phosphorus-boron interaction on sugar-beet	50
IV.2.1. Fresh weight	50

	Page
IV.2.2. Sugar quantity and quality	55
IV.2.3. Dry matter yield, content and uptake of nutrients by sugar-beet tops	55
IV.2.4. Dry matter yield, content and uptake of nutrients by sugar-beet roots	62
IV.3. The effect of potassium-boron interactions on sugar-beet	69
IV.3.1. Fresh weight	69
IV.3.2. Sugar quantity and quality	70
IV.3.3. Dry matter yield, content and uptake of nutrients by sugar-beet tops	75
IV.3.4. Dry matter yield, content and uptake of nutrients by sugar-beet roots	82
V. SUMMARY	89
VI. REFERENCES	92
ARABIC SUMMARY	

INTRODUCTION

Carbohydrates, as group, are compounds of highest importance, viewed from both the practical and theoretical aspects. They represent a great storehouse of energy as food stuffs for both human and animal.

In Egypt, sugar-cane is the only source of sugar industry. The average annual local sugar production amounts to 834848 tons (1987). Since the average local consumption of sugar is about 1529412 tons, it is apparent that there is a deficiency in local sugar production amounting to about 694564 tons which is expected to increase as a result of greater consumption of the over increasing population. Therefore, it is necessary to search for new sugar plants, other than sugar-cane, to increase the sugar production in Egypt and to face the demands of this increasing number of inhabitants.

Experiments carried out by the Ministry of Agriculture, Sugar Crops Institute, Agriculture Research Center, proved that sugar-beet can be successfully grown in both saline and calcareous soils where sugar-cane fails completely to grow and suggested sixty thousand feddans of the highly calcareous

soils at the northern region of El-Tahrir province to be cultivated with sugar-beet. Also, commercial production of sugar from sugar-beet, in Egypt, has been highly recommended by many investigators and several projects have been set out very recently for that purpose.

Therefore, the aim of this work is to study the effect of some macro and micro-elements, i.e., N, P, K and B at different concentrations, on the growth of sugar-beet as well as the quantity and quality of sugar yield under calcareous soil conditions.

II. REVIEW OF LITERATURE

II.1. The effect of nitrogen fertilization on sugar-beet:

In most sugar-beet growing regions of the world, nitrogen is the most important fertilizer element for plant growth. Generally, it usually increases the yield of crops, but the quality of the beet crop decline particularly with large dressings.

Halverson and Hartman (1975) studied the influence of long-term nitrogen rate and source on sugar beet yield and quality. They found that the highest sucrose yield (7.6 t/ha) was obtained with 112 kg N/ha as ammonium nitrate. However, the application rate greater than 112 kg N/h caused progressive decrease in sucrose yields, sucrose percentage, and dry matter root weights. Also, they added that increasing the rate of inorganic-N decreased dry matter root/top ratios.

On the other hand, Holmes et al. (1976) studied, through seven field experiments, the effect of five rates of applied nitrogen (0, 67, 134, 201 and 268 kg/ha) on the sugar yield and content in sugar-beet. They found that nitrogen gave substantial increase in sugar yield in all experiments, due essentially to increases in root yield but this was partially

off set by falls in sugar content at the higher nitrogen rates. Rucka (1977) studied the effect of nitrogen fertilization on yields of sugar-beet. He found that the sugar content of roots was increased from 9.4 to 14.9% and sugar yield from 2.88 to 9.2 t/ha as a result of the application of nitrogen as urea. Moreover, Saric and Jovic (1977) studied the effect of mineral nutrition on sugar-beet. They found that over 10 years periods the average of root yields were increased by 16% with increasing N rate from 0 to 150 kg/ha as compared with unfertilized control. Chochola (1978) studied nitrogen nutrition in sugar-beet in field trials at two sites in Czechoslovakia using 50 kg P + 170 kg K + 0, 60, 120 or 180 kg N/ha. He found that dry matter yield increased with applied N from 10.34 t/ha with PK to 15.24 t with PK + 180 kg N/ha, root yields increased from 37.8 t/ha up to 49.3 t/ha with PK + 120 kg N/ha and then decreased with 180 kg N/ha. Also, he found that refined sugar yield increased from 4.13 t/ha with PK to 5.35 t/ha with PK + 120 or 180 kg N/ha.

On the other hand, Johnson et al. (1978) studied the critical tissue levels for predicting nitrogen needs of

sugar-beet at Arizona in U.S.A. They found that the content of sucrose in the root was significantly decreased with addition of 80 lb N/acre, while root yield was increased which compensated for the decreased in sugar content, so that total sugar was significantly increased by added nitrogen. On the contrary, they also found that, in the next year, addition of nitrogen (100 lb N/acre) significantly reduced sugar yield but the slight increase in root yield did not compensate for the large decline in sucrose content. They added that petiolar $\text{NO}_3\text{-N}$ concentration gave the best correlation with sucrose and root yields ($r^2 = 0.64$ and 0.65 , respectively), maximum sugar yields were obtained when petiolar $\text{NO}_3\text{-N}$ levels were approximately 5000 ppm. Analogides (1979) showed that, under field conditions of the North of Greece, maximum root and sugar yields were obtained with 160 and 120 kg N/ha, respectively. He also, found that there are negative linear correlation between N fertilizer and sucrose content while root yield response to N tended to be smaller and the adverse effect of N on sucrose content decreased with increasing plant density. Yields of plant tops at harvest increased with increasing

the addition of nitrogen and plant population. Kurbel (1980) found a close positive correlation between N application rate and yields of roots and sugar of sugar beet, where the effect of N on root yields was rather greater than that on sugar yields. He added that the maximum rate of N application which gave a maximum root and sugar yield were 118-134 kg/ha and 129 kg/ha, respectively. However, Satti and Dennis (1981) indicated that low sugar yield in sugar-beet was attributed to low root sugar content caused by excess N in soil. Also, Nishimune et al. (1982) studied the utilization of nitrogen from chemical fertilizer and that released from soil organic matter by sugar-beet grown in different soil types. They found that applied N was negatively correlated with sugar concentration and positively correlated with sugar yields up to 150 kg/ha, then the yield decreased with increasing N. Last et al. (1983) found in some field experiments that sugar yield was linearly related to both dry matter yield and total nitrogen uptake by sugar-beet. However, the sugar yield did not increase with increasing the application rate of N above 200 kg/ha, while the maximum yields of sugar were normally

obtained with 125 kg N/ha. Vielemeyer et al. (1986) studied the effect of the nitrogen supply on the process of yield formation in sugar-beet. They found that increasing N rates from 0 to 240 kg/ha increased the fresh weight of shoot and root from 42.7 to 82.2 and 38.2 to 42.9 t/ha, respectively, but decreased sugar content from 17.1 to 15.7% and had no effect on total sugar yield.

Concerning the effect of level of nitrogen nutrition and nitrification inhibitors on the yield and quality of sugar-beet, Semenishen (1982) found that, in field trials, root yields of sugar-beet were significantly increased with 90-120 N/ha applied with N-serve compared with N alone. Also, he added that application of nitrification inhibitors to 210 kg N/ha gave insignificant increase in yield.

Regarding N content in dried sugar-beet at harvest, Draycott (1972) reported that the concentrations of nitrogen were 3.0%, 0.6% and 1.4% for leaves, root and petioles, respectively. Chumak (1977) reported that N fertilization increased the total N content of sugar-beet. Last and Draycott (1979) and Sanchez et al. (1982) showed that the uptake of nitrogen by roots and tops was increased with

increasing the application rate of N as ammonium nitrate, while the sugar content and juice purity were decreased. Vilsmeier (1984) studied nitrogen balance in lysimeter trials with sugar-beet using ^{15}N -labelled calcium ammonium nitrate or ammonium nitrate applied at 0, 120 and 180 kg N/ha. He found that increasing N rate increased root fresh weight yield, N content, and total N-uptake. Izsa'Ki (1984) studied the effect of N fertilization on the dry matter accumulation and NPK uptake by sugar-beet grown on chernozem meadow soil and treated with 0, 80, 120, 240 and 320 kg N/ha. He found that the total dry matter production increased with N application but it was unaffected by the rate of application. Also, he added that N application increased plant N content, at high application rates, plant K content decreased. However, tuber N:P and N:K ratios increased at higher N application rates but the leaf K:P ratio decreased.

II.2. The effect of phosphorus fertilization on sugar-beet:

Draycott et al. (1972) studied the long-term effect of P-fertilizer at Broom's Barn (Rothemsted Exp.) on yield content and uptake of phosphorus by sugar-beet. They demonstrated that the average increase in yield by phosphorus fertilizers was about 3-6% of the mean yield, where the