OPTIMIZATION OF SUGAR BEET NUTRITION IN SANDY SOIL

BY

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M.Sc. Agric., Sci. (Plant Physiol.), Ain Shams University, 199[illegible]

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

DOCTOR OF PHILOSOPHY

In
Agricultural Science
(Plant Physiology)

Department of Agriculture Botany
Faculty of Agriculture
Ain Shams University

1999

APPROVAL SHEET

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ABSTRACT

Sayed Said Shaaban Eisa, Optimization of sugar beet nutrition in sandy soil. Unpublished Doctor of Philosophy, Dept. of Agriculture Botany, Fac. Of Agric. Univ. of Ain Shams, 1999.

This study was conducted to find out the effect of nitrogen and/or boron nutrition on growth and some physiological responses of sugar beet plants growing under sandy soil and irrigated with different NaCl salinity levels. The result obtained cleared that raising nitrogen level around sugar beet media, without NaCl addition induced maximum root fresh weight though, sucrose concentration was less against low N level (90 kg). However, water consumption was doubled by high N level. On the other hand, low N combined with NaCl treatment of late salinity application produced similar root fresh weight and sugar yield as the unsalinized plants. Exposure to salinity directly after sowing, with both concentration as well high concentration added late (9 weeks after sowing) negatively affected N fertilization on crop tolerance that reflected on reducing root fresh weight. The harmful effect was more elevated when the high nitrogen level was applied.

Sodium accumulation reduced K/Na ratio in the top, Rubisco concentration in mesophyl tissue and increased PEPCase activity of sugar beet leaves, which may be considered as the main photosynthethic stress enzyme. Such conclusion can be seen from the clear decline of root/top ratio which reflected in tern on the lowest root fresh weight yield of the plant. To avoid the deleterous effect of salinity, the sodium absorbed was translocated to the foliage to replace most of potassium. Sodium partitioning was detected firstly in epidermis layers to protect the mesophyll cells from the harmful effect of salinity. As sodium concentration raised in the root media, it accumulated in root concomitant with the redistribution of K from the epidermal leaf cells to sensitive tissue.

Key words: Sugar beet; Sandy soil; Nitrogen; Boron; Salinity; Root/top ratio; Sucrose; Glucose; K/Na ratio; Sodium partitioning; Rubisco; PEPCase; EDXA; ABA; Cell culture.

ACKNOWLEDGMENT

The writer wishes to express his deep appreciation and sincere gratitude to **Prof. Dr. A. Raafat, Professor of Plant Physiology, Agricultural Botany Department, Faculty of Agriculture, Ain Shams University** for his supervision, suggesting the problem, unfailing guidance and continuous help that made this work possible.

Highly appreciation and deepest thanks to **Prof. Dr. M.A. Amer, Professor of Plant Physiology, Agricultural Botany Department, Faculty of Agriculture, Ain Shams University** for his supervision, constant guidance and constructive criticism throughout the course of this work.

I wish to extend my appreciation and gratitude for **Dr. S. Shehata, Assoc. Professor of Plant Physiology Agricultural Botany Department, Faculty of Agriculture, Ain Shams University** for his supervision and great help. Also, all my deepest gratitude and my sincerest thanks are due to **Prof. Dr. M.A. Bondok, Professor of Plant Physiology, Agricultural Botany Department, Faculty of Agriculture, Ain Shams University** for his valuable help.

The author wished to express his deepest gratitude and indebtedness to **Prof. Dr. K.H. Neumann, Professor of Biochemistry, Institute of Plant nutrition, Justus liebig University, Giessen, Germany**, for his fruitful supervision, valuable guidance, unlimited support, kindly offering all the facilities of his laboratory, help and encouragement throughout the course of this work, to whom I am deeply indebted.

I feel deeply thankful and very grateful to **Dr. B. Pauler, Doctor of Biochemistry, Institute of Plant Nutrition, Justus Liebig University, Giessen, Germany**, for his great and kindly help in chemical analysis and **Dr. U. Gross, Klinische Biochemie, Marburg University, Marburg, Germany**, for his valuable help in determination of photosynthesis enzymes. Sincere gratitude should also be expressed to **Dr. H.W. Koyro, Biotechnical Unit, Justus Liebig University, Giessen, Germany** for the innovative concept and help in EDXA Studies.

I also wish to express my sincere thanks and gratitude to all members of Institute of Plant Nutrition Giessen, Germany and Agriculture Botany Department Faculty of Agriculture, Ain Shams University, for kind help in the field and laboratory work.

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INTRODUCTION

The sugar beet is one of the main sugar crops in the world that provide human being with a high energy pure food. Along with sugar cane, they provide the 70 million tons of sugar consumed annually in the world. The two crops, sugar cane and sugar beet, contribute 55 and 45 percent of the world sugar supply, respectively.

In 1982, sugar beet has been introduced in Egypt as new sugar crop and a second source for sugar production after sugar cane to minimize the gap between production and consumption of sugar and thus meet the nutritional demand of the vast growing population (62 million) in the country. Meanwhile, this aimed as well to bring new land to the limited arable area of Nile Valley (4% of the total area) and to apply non-traditional systems of irrigation for efficient use of water resources.

Regarding, however, the uncultivated land in Egypt, deserts are found to mainly occupy 96% of the total area. They are mostly consisted of sandy soils characterized by high water infiltration, low water holding capacity, and inherently low in nutrients required for plant growth. Accordingly, cultivation of these soils requires modern techniques for both irrigation and fertilization.

Planning fertilization of sandy soils should generally include all essential elements. However, among these different nutrients, nitrogen ranks first in priority, since it is required by plants in substantial quantities and therefore is considered the key limiting factor for crop production under these conditions. Consequently, in order to fulfill the crop requirements for nitrogen in sandy soil, the effect of nitrogen level has to be studied for maximizing yield productions.

2. REVIEW OF LITERATURE

The literature relevant to the aspects listed in the introduction is briefly reviewed under the following headings.

2.1. Effect of nitrogen fertilization:

2.1.1. Growth and yield:

Draycott and Webb (1971) studied the effect of nitrogen fertilizer levels (0, 0.6, 1.2 and 1.8 cwt. $acre^{-1}$) on sugar beet. They reported that nitrogen increased root yield greatly, especially the first N level 0.6 cwt. $acre^{-1}$; the increase from the second and third 0.6 cwt. was much less. Nitrogen decreased sugar content but the low level 0.6 cwt. $acre^{-1}$ had less effect than the higher one. Sugar yield was increased greatly by the first N level 0.6 cwt. $acre^{-1}$, slightly by a further addition 0.6 cwt. $acre^{-1}$ and decreased slightly but not significantly by more nitrogen. **Halvorson and Hartman (1975)** found that application of nitrogen reduced root/top ratio in sugar beet plants. **James *et al.* (1978)** studied the effect of soil nitrogen fertilizer at different rates (0, 84, 210 and 525 kg. ha^{-1}) on sugar beet root yield and sucrose percent. They found that the N-0 plots appeared N deficiency symptoms very early and the canopy in these plots never completely covered. In the N-84 plots, N deficiency symptoms began to appear in June and in the N-210 plots in August. In the N-525 plots the canopy remained dark green and massive throughout the season. At the highest level (525 kg. ha^{-1}), yield was generally increased and sucrose percent was decreased. **Akeson *et al.* (1979)** studied the effect of five different nitrogen rates (0, 67, 134, 202 and 269 kg. ha^{-1}) on sugar beet root yield and its quality. They concluded that total root yield increased from 45.2 to 84.4 metric tons ha^{-1} with increasing the nitrogen application rates