EFFECT OF COBALT ON THE GROWTH AND MINERAL COMPOSITION OF PLANT

BY

NADIA GAD EL-RAB SHEHATA

A thesis submitted in partial fulfillment

of

the requirments for the degree of

MASTER OF SCIENCE

IN

Agriculture

(Soil Science)

Department of Soil Science

Faculty of Agriculture

Ain Shams University

1989

Approval Sheet

EFFECT OF COBALT ON THE GROWTH AND MINERAL COMPOSITION OF PLANT

BY

NADIA GAD EL-RAB SHEHATA

B.Sc. Agric., (Horticultural Dept.) Ain Shams Univ., (1982)

B.Sc. Agric., (Soil Science Dept.) Ain Shame Univ., (1985)

This thesis for (M.Sc.) degree has been approved by :

Prof Dr. Mohamed S. Omran .....

Prof. of Soil Science., Soil Science Dept. Menoufeia Univ.

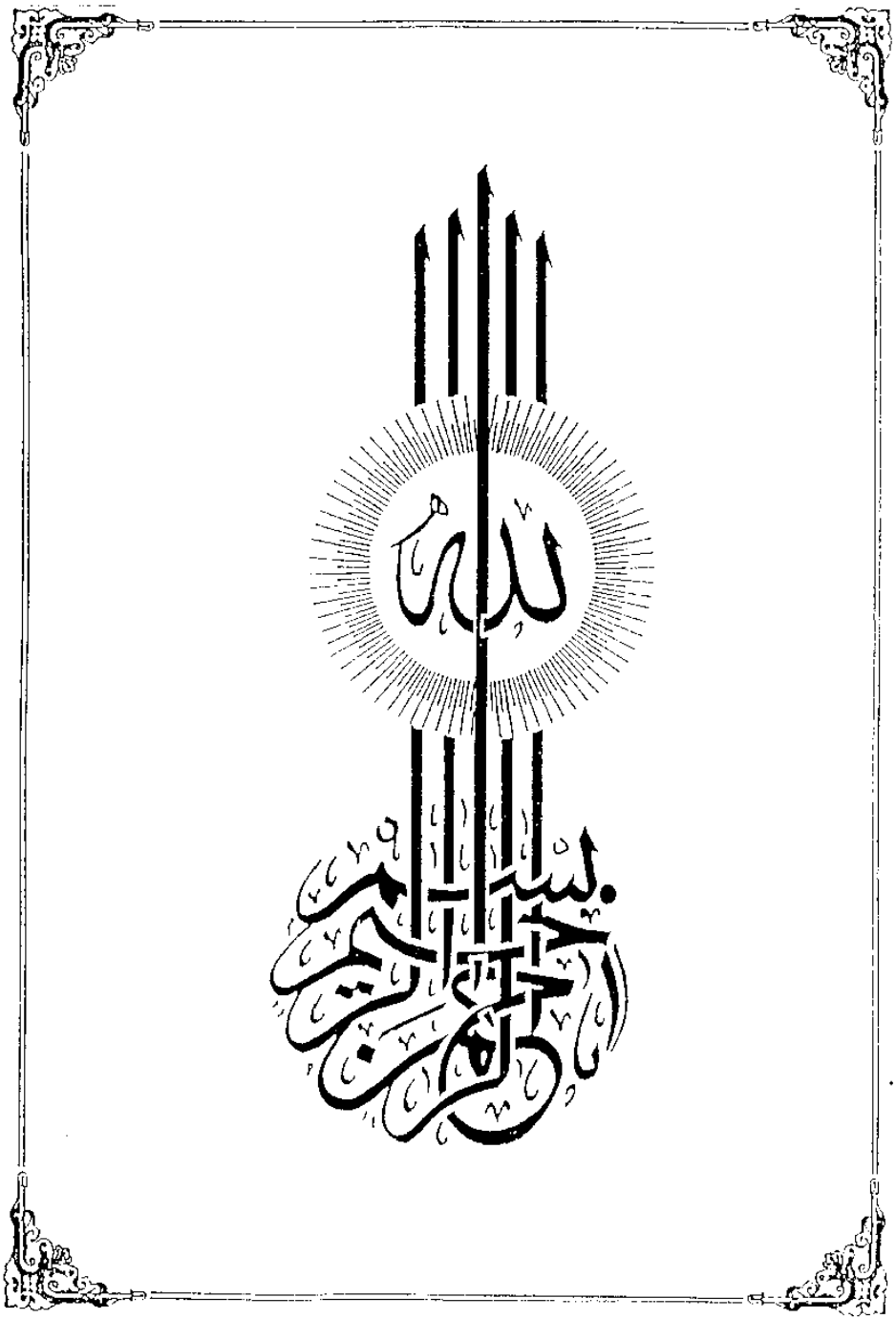
Prof. Dr. Adel S. El-Beltagy .....

Prof. of Vegetable Crops, Horticultural Dept. Ain Shams Univ.,

Prof. Dr. Mohamed N. El-Awady .....

Prof. of Agric., Engineering, and Head of Soil Science Dept., Ain Shams Univ.

Date of examination : .....



EFFECT OF COBALT ON THE GROWTH AND MINERAL COMPOSITION OF PLANT

BY

NADIA GAD EL-RAB SHEHATA

B.Sc. Agric., (Horticultural Dept.) Ain Shams Univ., (1982)

B.Sc. Agric., (Soil Science Dept.) Ain Shame Univ., (1985)

Under the Supervision of : Prof. Dr. Talaat M. El-Kobbia

Prof. of Soil Science Dept. Ain Shams University.

ABSTRACT

This research was carried out on tomato (Lycopersicon esculentum Mill. cvs UC 97) and squash (Cucurbita pepo cvs Eskandarani) plants under glasshouse and / or lath-house conditions at the winter and spring time of 1987-1989. Experiments were conducted in 3 main parts which are summerized as follow :

PART I EFFECT OF COBALT ION ON TOMATO PLANT GROWTH AND MINERAL CONTENT

Supplementing the nutrient solutions in which tomato plants were grown with 0.25 ppm of Co ion, induced plant shoot and root growth. Increasing Co concentration in the growing media up to 0.5 ppm, eliminat the possitive effect of 0.25 ppm of Co treatment on plant growth. All parameters of plant growth significantly reduced as Co concentrations rose above 0.5 ppm, while catalase and peroxidase enzyme activities were significantly increased. Symptoms of chlorosis started to appear on plant upper or new leaves at 0.5 ppm of Co application and clearely increased as Co cencentrations increased. While plant content of Co, Mn and Zn increased significantly with inereasing Co concentration in the growing media, Fe content strongly reduced. Doubling Fe concentration in the nutrient solution with the presence of 0.5 ppm Co, eliminates upper leaves chlorosis and increases plant shoot and root content of Fe with a great reduction in Co content. It is indicated from these data that Fe and Co are competitive elements in tomato plant nutrition and the appearance of chlorosis on the upper leaves under high levels of Co application is due mainly to iron deficiency.

PART II EFFECT OF COBALT ION ON THE FORMATION, GROWTH AND DEVELOPMENT OF ADVENTITIOUS ROOT IN TOMATO AND SQUASH SEEDLINGS

Adventitious root formation on tomato cuttings (excised shoots of the seedlings) were totally inhibited with the

application of anti-ethylene biosynthesis (1 mM AOA or 2mM Co) or action (2 mM STS). Overcoming the inhibitory effect of AOA application were obtained with 200 ppm of ethryl application. Increasing ethryl concentration up to 250 ppm induced adventitious root formation on the hypocotyl and prevented its formation on the epicotyl. Auxin application of AOA treated tomato cuttings however, induced adventitious root formation only on the epicotyl. It seems that C_2H_4 has an important role on auxin action and transport and subsequently on its effect on adventitious root formation. Ethryl application of 200-500 ppm increased adventitious root number on squash cuttings to about 8-10 fold in comparison with that of control. It is concluded from these data that C_2H_4 is an essential hormone in the formation of adventitious root and it is controlling auxin effect.

Supplementing the nutrient solution with 0.25 ppm Co induced adventitious root formation on tomato and squash cuttings and increased C_2H_4 production by both plants. Increasing Co concentration to 0.5 ppm caused further stimulation in adventitious root formation and growth as well as C_2H_4 production by squash plants.When Co concentrations rose above 0.5 ppm, advetitious root formation and C_2H_4 production were strongly reduced in both plants. These data showed that the formation of adventitious root is parallel to plant C_2H_4 production and low levels of Co application induced C_2H_4 production while high levels inhibited it.

Rising basal levels of C_2H_4 in squash seedlings with Co application to that of untreated tomato seedlings increased the percentage of successful transplanting from 12 to 100% . These data strongly suggest that transplanting failure in some plant species is mainly due to their low levels of basal C_2H_4.

PART III EFFECT OF COBALT ION ON TOMATO AND SQUASH PLANTS WATER BALANCE

Supplementing the nutrient solutions in which tomato and squash cuttings (excised shoots of the seedlings) were grown with 0.00 , 0.25 ,0.50 and 1.00 ppm of Co reduced water loss of both plants. This reduction increased significantly by about 40 to 70 % with increasing Co concentrations up to 0.5 or 1.0 ppm respectively. Cobalt application caused a remarkable increase in the percentage of stomatal closure in either tomato or squash leaves by about 79 or 62 % respectively. Analyzing ABA content in both plants showed that as Co concentrations increased in the nutrient solutions, plant shoot and root content of ABA increased significantly . Auxins and gibberellins levels however, were significantly reduced with high levels of Co application. Ethylene production were strongly reduced in both plants with the application of 1 ppm Co and caused a remarkable reduction in the epinasty of squash cotyledon leaves than natural epinasty degree. Reducing natural epinasty degree of the leaves may reduce direct exposure of the leaves to sun light which may reduce plant water loss. It is evident from these data

That ABA strongly induces plant stomatal closure even with the remarkable reduction of C_2H_4 occured with 1 ppm of Co application. These data strongly suggest that Co applcation induces plant stomatal closure through increasing ABA levels and reduces natural epinasty degree of the leaves by reducing basal levels of C_2H_4 and these changs were behined the significant reduction in plant water loss .

DIDICATION

AS A DEED OF THANKFULNESS AND GRATITUDE,

I DEDICATE MY THESIS TO THE NAME

OF THE RIGHT HONOURABLE THE LATE

PROFESSOR TALAAT EL-KOBBIA UNDER

WHOSE KIND CARE AND SUPERVISION IT WAS DONE

ACKNOWLEDGMENT

I wish to express my deep sense of gratitude, to prof. Dr. Talaat El-Kabbia, prof. of Soil Science Dept., Faculty of Agric. Ain Shams Univ., for supervising and planning this research, as well as his valuable guidance, continuous advice and encouragement.

I would like to extend my sincere gratefulness, to Dr. Mordy A. Atta-Aly, Assis. Prof. Horticultural Dept., Faculty of Agri., Ain Shams Univ., for his supervising as well as his guiding thoughts, beside his step by step practical sharing by which this thesis has came to be in this form.

Thanks are also due to Dr. Adel .S. El-Beltagy, Prof. of Vegetable Crops, Horticultural Dept., Faculty of Agric., Ain Shams Unive., for facilities offered through his office.

I am also grateful to prof. Dr.Mohamed N. El-Awady prof., of Agric., Engineering, and Head of the Soil Science Dept., Ain Shams Univ.

I am grateful to prof. Dr. Fahd El-Abbasy Prof., of Soil Science Dept. Ain Shams Univ., for his help and encouragement.

I have to express my deep thanks to prof. Dr. Mamdouh H. Abbas, Prof., of Fruit Crops, National Research Center for his great help.

CONTENTS

LIST OF TABLES

LIST OF FIGURES