

EFFECT OF COBALT ON THE GROWTH AND
MINERAL COMPOSITION OF PLANT

BY

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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 concentrations 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, adventitious 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 occurred with 1 ppm of Co application. These data strongly suggest that Co application 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 changes were behind 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

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CONTENTS

	Page
LIST OF TABLES	1 - 2
LIST OF FIGURES	3 - 4
LIST OF PHOTOPRINTS	5 - 6
INTRODUCTION	7
 I REVIEW OF LITERATURE	
I 1 Effect of cobalt ion on tomato plant growth and mineral content.....	8 - 11
I 2 Effect of cobalt ion on formation, growth	12 - 15
I 3 Effect of cobalt ion on tomato and squash water balance.	16 - 18
 II MATERIALS AND METHODS	
II 1 Effect of cobalt ion on Tomato and squash water balance.....	19 - 21
a. Plant Material.....	19
b. Cobalt Treatments.....	19
c. Growth Analysis.....	20
d. Minerals Determination.....	20
e. Chlorophyll Measurements.....	20
f. Determination of Peroxidase and Catalase Enzyme Activities.....	21
g. The Chlorosis Recovery Experiments....	21
 II 2 Effect of cobalt ion on the formation, Growth and Development of Adventitious root in Tomato and squash seedlings.....	22 - 25
a. Treatment of Tomato Cuttings.....	22
b. Ethylene Inhibitors and Ethrel Treatments	23

	Page
c. Treatments of Squash Cuttings.....	24
d. Parameters of Adventitious Root Growth	25
e. Measuring Ethylene Production.....	26
II 3 Effect of Cobalt ion on tomato and squash plants water balance.....	26 - 30
a. Measurements of Water Consumption by Volumetric Method.....	28
b. Measurements of Water Loss by Weight...	29
c. Stomata print.....	29
d. Measurements of Auxins, Gibberellins and Abscissic acid.....	30
III RESULTS AND DISCUSSION	
III 1 Effect of Cobalt ion on tomato plant growth and mineral content.....	31 - 45
III 2 Effect of Cobalt ion on the formation, growth and development of adventitious root in tomato and squash seedlings.....	46 - 58
III 3 Effect of Cobalt ion on tomato and squash plants water balance.....	59 - 70
IV SUMMARY AND CONCLUSIONS	71 - 75
IIV REFERENCES	76 - 84
IIIV ARABIC SUMMARY AND CONCLUSION	8 - 1

LIST OF TABLES

Part	Number	Title	Page
I	1 a	Effect of supplementing the nutrient solutions with cobalt ion on the growth of tomato plants (Frist season).....	34
	1 b	Effect of supplementing the nutrient solutions with cobalt ion on the growth of tomato plants (Second season).....	35
	2	Effect of supplementing the nutrient solutions in which tomato plants were grown with cobalt ion on plant shoot and root content of Co, Fe, Mn and Zn one month after application.....	36
	3	Effect of supplementing the nutrient solutions in which tomato plants were grown with cobalt ion on shoot's apical part content of Fe and Co one month after application.....	37
	4	Effect of doubling iron content in cobalt supplemented nutrient solutions in which tomato plants were grown on plant shoot and root content of Fe and Co one month after application.....	38

Part	Number	Title	Page
II	1	Effect of dipping the stem (hypocotyl and epicotyl) of tomato cuttings in ethryl for 15 minuts on the formation and growth of adventitious root	51
	2	Effect of dipping the stem (hypocotyl and epicotyl) of tomato cuttings in auxin or ethryl for 5 seconds or 15 minuts respectively on the formation and growth of adventitious root. Cutting were stem dipped for one hour in H ₂ O or 1 mM AOA or 2 mM STS one day before 500 ppm of auxin or 200 ppm of ethryl application.....	52
	3	Effect of dipping the stem (hypocotyl) of squash cuttings in IBA or ethryl on the formation and growth of adventitious root for 5 seconds or 15 minuts respectively	53
III	1	Effect of supplementing the nutrient soluions in which tomato and squash cuttings were transplanted with cobalt ion on stomatal closure one week after transplanting...	62

LIST OF FIGURES

Part	Number	Title	Page
I	1	Effect of supplementing the nutrient solutions in which tomato plants were grown with Co ion on plant fresh weight, dry weight and %dry matter one month after application.....	39
	2	Effect of supplementing the nutrient solutions in which tomato plants were grown with Co ion on catalase and peroxidase enzyme activities one month after application	40
	3	Effect of supplementing the nutrient solutions in which tomato plants were grown on chlorophyll content of lower and upper leaves one month after application.....	42
	4	Effect of doubling iron content in Co supplemented nutrient solution in which tomato plants were grown on chlorophyll content of lower and upper leaves one month after application.....	43
II	1	Effect of supplementing the nutrient solutions in which tomato and squash cuttings were grown with cobalt ion on plant ethylene production.....	54
III	1	Effect of supplementing the nutrient solutions in which squash cuttings were transplanted with cobalt ion on plant water consumption.....	63