

PHYSIOLOGICAL RESPONSE OF TOMATO TO LOW TEMPERATURE

By

SANAA MOHAMED ABDEL HALIM

A thesis submitted in partial fulfillment
of

The requirement for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Science

(Vegetable Crops)



33 7.2

Department of Horticulture
Faculty of Agriculture
Ain Shams University



1990

Approval Sheet

PHYSIOLOGICAL RESPONSE OF TOMATO TO LOW TEMPERATURE

By

SANAA MOHAMED ABDEL HALIM

B. Sc. (Agr.) Plant Production, Ain Shams Univ., 1973.

M. Sc. (Agr.) Horticulture, Ain Shams Univ., 1984.

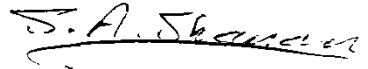
This Thesis for Ph. D. Degree has been

Approved by :

Prof. Dr. Mostafa Kamel Imam
Vice Dean of Faculty of Agriculture,
Assuit University.



Prof. Dr. Shamel Ahmed Shanan
Prof. and Head of Hort. Dept.
Al-Azhar University



Prof. Dr. Hosnia Gomaa
Prof. of Vegetable Crops.
Hort. Dept. Ain Shams University



Date of Examination : 31/10/1990



PHYSIOLOGICAL RESPONSE OF TOMATO TO LOW TEMPERATURE

By

SANAA MOHAMED ABDEL HALIM

B. Sc. (Agr.) Plant Production, Ain Shams Univ., 1973

M. Sc. (Agr.) Horticulture, Ain Shams Univ., 1984

Under the Supervision of : Prof. Dr. Hosnia Gomaa
Prof. of Vegetable Crops
Hort. Dept. Ain Shams Univ.

Prof. Dr. Ibrahim El-Oksh
Prof. of Vegetable Crops
Hort. Dept. Ain Shams Univ.

ABSTRACT

Preliminary experiments were carried out to study the effect of treating dry or soaked tomato seeds with different low temperatures for different intervals on the ability of tomato plants to tolerate low temperature injury and its reflection on growth, flowering and yield. The results of these experiments showed that 6 hrs. soaking period, -1°C and 5°C temperature treatments for one or seven days were the convenient treatments among all the treatments tested.

Pot and field experiments were carried out to study the effect of treating dry or soaked tomato seeds with -1°C and 5°C temperatures for one or seven days on tomato plants and its yield.

These treatments showed distinct effects on both vegetative and reproductive growth of the plants.

Hormonal analysis of the treated and untreated tomato seeds showed significant increase in the amount of growth promoters (namely IAA, GA-like substances and cytokinins) and marked decrease in the amount of growth inhibitors (namely ABA). 5°C chilling temperature for seven days resulted in the appearance of three newly fatty acids, two of which are saturated and the third is unsaturated.

DEDICATION

I would like to dedicate this work to my husband Medhat El-Gazzar. I must apologise to my husband and my sons Mohamed, Ahmed and Mahmoud, to whom I present this Thesis, for missing me some times during the course of my study and hope they will forgive me.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude to Prof. Dr. Hosnia Gomaa, Prof. of Vegetable crops, Horticulture Dept., and Prof. Dr. Ibrahim El-Oksh, Prof. of Vegetable crops, Horticulture Dept., Faculty of Agriculture, Ain Shams University, for continuous advice and valuable guidance.

Great thanks are also due to Prof. Dr. Sohair Khalil Prof. of Plant Physiology and Prof. Dr. Magda Kandil Prof. of Plant Physiology, Botany Dept., National Research Centre.

Great thanks are also due to Dr. Ragaa M. Imam Botany Dept., National Research Centre, for her help during this work.

Sincere thanks to my colleagues in the Botany Dept., National Research Centre, for their help.

CONTENTS

	<u>Page</u>
INTRODUCTION	1
REVIEW OF LITERATURE	2
MATERIAL AND METHODS	20
RESULTS	42
A. PRELIMINARY STUDIES.	
1. Effect of soaking period on moisture percentage of tomato seeds.....	42
2. Effect of low temperatures and exposure periods on germination percentage.....	42
3. Effect of soaking, low temperatures and exposure periods on seedling emergence.....	47
B. POT EXPERIMENTS.	
I. Effect of treating tomato seeds with soaking and low temperatures on the ability of tomato plants to tolerate low temperature injury during seedling stage. (Sown in December)	
1. Vegetative growth parameters	50
2. Reproductive growth parameters	64
II. Effect of treating tomato seeds with soaking and low temperatures on the ability of tomato plants to tolerate low temperature injury during flowering stage (Sown in October)	
1. Vegetative growth parameters	90
2. Reproductive growth parameters	98

Page

C. FIELD EXPERIMENTS.	
I. Effect of treating tomato seeds with soaking and low temperatures on the ability of tomato plants to tolerate low temperature injury during seedling stage. (Sown in December)	
1. Vegetative growth parameters	126
2. Reproductive growth parameters	134
II. Effect of treating tomato seeds with soaking and low temperatures on the ability of tomato plants to tolerate low temperature injury during flowering stage. (Sown in October)	
1. Vegetative growth parameters	146
2. Reproductive growth parameters	155
D. CHEMICAL ANALYSIS OF TREATED SEEDS.	
1. Effect on total proteins and total carbohydrates.....	166
2. Effect on oil contents	166
3. Effect on endogenous hormones	171
GENERAL DISCUSSION	182
SUMMARY	193
REFERENCES	198
ARABIC SUMMARY.	

* * *

LIST OF TABLES

	<u>Page</u>
RESULTS	
B. POT EXPERIMENTS	
Table (1-1): Effect of treating tomato seeds with soaking and low temperatures on plant height,season 1987	51
Table (1-2): Effect of treating tomato seeds with soaking and low temperatures on plant height,season 1988.	53
Table (1-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on plant height,seasons 1987, 1988	54
Table (2-1): Effect of treating tomato seeds with soaking and low temperatures on number of branches per plant,season 1987	56
Table (2-2): Effect of treating tomato seeds with soaking and low temperatures on number of branches per plant,season 1988.	57
Table (2-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of branches per plant, seasons 1987,1988	58
Table (3-1): Effect of treating tomato seeds with soaking and low temperatures on number of leaves per plant,season 1987.	60

	<u>Page</u>
Table (3-2): Effect of treating tomato seeds with soaking and low temperatures on number of leaves per plant, season 1988.	62
Table (3-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of leaves per plant, seasons 1987, 1988.	63
Table (4-1): Effect of treating tomato seeds with soaking and low temperatures on number of flowers per plant, season 1987	65
Table (4-2): Effect of treating tomato seeds with soaking and low temperatures on number of flowers per plant, season 1988.	66
Table (4-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of flowers per plant, seasons 1987, 1988	67
Table (4-c): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on total number of flowers per plant, seasons 1987, 1988	70
Table (5-1): Effect of treating tomato seeds with soaking and low temperatures on number of fruit set per plant, season 1987.	72
Table (5-2): Effect of treating tomato seeds with soaking and low temperatures on number of fruit set per plant, season 1988.	73
Table (5-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of fruit set per plant, seasons 1987, 1988	74

	<u>Page</u>
Table (10-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on plant height, seasons 1988 and 1989.	93
Table (11-1): Effect of treating tomato seeds with soaking and low temperatures on number of branches per plant, season 1988	95
Table (11-2): Effect of treating tomato seeds with soaking and low temperatures on number of branches per plant, season 1989	96
Table (11-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of branches per plant, seasons 1988 and 1989..	97
Table (12-1): Effect of treating tomato seeds with soaking and low temperatures on number of leaves per plant, season 1988	99
Table (12-2): Effect of treating tomato seeds with soaking and low temperatures on number of leaves per plant, season 1989	100
Table (12-3): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of leaves per plant, seasons 1988 and 1989.	101
Table (13-1): Effect of treating tomato seeds with soaking and low temperatures on number of flowers per plant, season 1988	102
Table (13-2): Effect of treating tomato seeds with soaking and low temperatures on number of flowers per plant, season 1989	104
Table (13-3): Effect of treating tomato seeds with soaking, low temperature or exposure periods on number of flowers per plant, seasons 1988 and 1989.	105

Table(13-c): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on total number of flowers per plant, seasons 1988, 1989	108
Table (14-1):Effect of treating tomato seeds with soaking and low temperatures on number of fruit set per plant,season 1988	109
Table (14-2):Effect of treating tomato seeds with soaking and low temperatures on number of fruit set per plant,season 1989	110
Table (14-3):Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of fruit set per plant, seasons 1988, 1989	112
Table(14-c): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on total number of fruit set per plant, seasons 1988, 1989	114
Table (15-a):Effect of treating tomato seeds with soaking and low temperatures on number of fruit yield per plant,seasons 1988, 1989	116
Table (15-b):Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of fruit yield per plant,seasons 1988, 1989	117
Table (16) : Effect of treating tomato seeds with soaking, low temperatures or exposure periods on total number of fruit yield per plant,seasons 1988, 1989	120
Table (17-a):Effect of treating tomato seeds with soaking and low temperatures on weight of fruit yield per plant,seasons 1988, 1989	121

Page

Table (17-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on weight of fruit yield per plant, seasons 1988, 1989	123
Table (18): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on total weight of fruit yield per plant, seasons 1988, 1989	125
C. FIELD EXPERIMENTS.	
Table (1-a): Effect of treating tomato seeds with soaking and low temperatures on seedling measure- ments.	127
Table (1-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on seedling measurements.	128
Table (2-a): Effect of treating tomato seeds with soaking and low temperatures on growth parameters. .	129
Table (2-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on growth parameters.	131
Table (3-a): Effect of treating tomato seeds with soaking and low temperatures on leaf measurements. .	135
Table (3-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on leaf measurements.	136

Page

Table (4-a): Effect of treating tomato seeds with soaking and low temperatures on number of flowers per plant,	137
Table (4-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on number of flowers per plant,	139
Table (5-a): Effect of treating tomato seeds with soaking and low temperatures on fruit yield per plant,	141
Table (5-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on fruit yield per plant,	144
Table (6-a): Effect of treating tomato seeds with soaking and low temperatures on fruit yield per feddan	142
Table (6-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on fruit yield per feddan.	145
Table (7-a): Effect of treating tomato seeds with soaking and low temperatures on seedling measurements	147
Table (7-b): Effect of treating tomato seeds with soaking, low temperatures or exposure periods on seedling measurements.	148
Table (8-a): Effect of treating tomato seeds with soaking and low temperatures on growth parameters .	150