# GENETICAL AND PHYSIOLOGICAL STUDIES ON THE NATURE OF SALT TOLERANCE IN TOMATO

BY

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بسم الله الرحمن الرحيم

وقل اعملوا فسيرى الله عملكم ورسوله والمؤمنون

- صدق الله العظيم -

بسم الله الرحمن الرحيم

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## DEDICATION

I WOULD LIKE TO DEDICATE THIS DISSERTATION TO:

* My Wife

* My Daughters, Omneia and Amira.

# CONTENTS

# I. General Introduction

Tomato (Lycopersicon esculentum,L) is the most important vegetable crops grown in A.R.Egypt. Acreage planted With this crop in 1986 was approxmately 394320 feddans and its productivity was 4455939 tons *

The increasing demands of the expanding population for food and energy necessitate the increase of arable land by exploiting marginal areas such as arid and semi -arid lands which comprise about 40 % of the world's land surface. Such areas are characterized by high salinity in the soil and in the major water resources.

One approach to the exploitation of these regions which otherwise are suitable for tomato production is the improvement of the salt to lerance of cultivated species. This may be achieved by exploiting intraspecific variability or, in species lacking such variability, genes may be transfered from closely related wild species adopted to high salinity.

Plant breeders are faced with the formidable task of screening the vast number of accessions in the tomate germplasm bank to locate useful sources of tolerance to salinity stress. These ecotypes may porsess sufficient genetic potential for introgressing salt tolerance into cultivars of L. esculentum. However, critical information on the genetic control of responses is noticeably absent and is essential for effectively designing a breeding strategy.

Although appreciable progress has been made in the general understanding of the physiology of the plant-salt relationships, there is a lack of a comprehensive understanding of the principal physiological information to breeding. Moreover, physiological effects of salinity on tomato are not fully known, the measurement of salt tolerance is difficult, and the concept is poorly defined. Almost nothing is known about the genes that affect salt tolerance.

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* Department of Agricultural Economics and statistice, Ministry of Agriculture, A.R.E., 1986.

Therefore the objectives of this work were as follows :-

1- Screening of Lycopersicon species for high tolerance at specific developmental stages to identify genotypes that might serve as gene sources for salt tolerance in the cultivated tomato.

2- Comparing some wild salt-tolerant ecotypes of tomato with L. esculentum including a salt-sensitive cultivar (Ace), and EdKawy cultivar which may potentially have salt tolerant attributes since it is grown in saline afflicted soils along the north coast of Egypt.

3- Physiological and biochemical determinants of salt tolerance.

4- Information on the genetic control of salinity tolerance which is essential for effectively designing a breeding strategy.

## 1.2 MATERIALS AND METHODS

Seeds of tomato cultivars: Edkawy (From El-Bosaialy Area,Egypt); Ace, Strain B and E6203 (From EAO) and UC 82 and VF 145-B 78 (From A.R.D) were sown in Jiffy pots (# 7), in the second week of september and irrigated with tap water till full emergence. Thereafter, they were irrigated with saline water (0, 2500, 5000, 7500 and 10000 ppm NaCl/CaCl ,3:1 in ratio ) using stepwise increase in salt concentration technique. A split polt design with three replicates was adopted. Cultivars were assigned as main plants whereas salt concentration was considered as the subplots.

Four seedlings, one month old were transplanted intoplastic pots , each was filled with 15 kg of sandy soil(from EL-Bosaily area, Egypt) mixed with $2.8_g$ $N_2$, $2_g$ $P_2O_5$ and 1g K O and they were daily irrigated with the different salinity concentration up to the field capacity , the drainage water was used again for further irrigation .

After 30 and 60 days from transplanting each pot received 1g of a compound fertilizer (1:1:1. $N_2$ - $P_2$ $O_5$ - $K_2$ O ) and at 45 and 90 days each pot received 50 ml of Hoagland solution containing all the micronutrients.

The following parameters were recorded.

1- Plant height (in cm) at 15, 30, 45, and 60 days from transplanting.

2- Number of clusters/plants:calculated at the end of the season.

3- Number of fruits/plants : determined all over the harvesting season.

4- Total yield/plant : the average yield was calculated from all harvested fruits for each experimental plot.

5- Fruit T.S.S., determined for three harvests at the red stage using a Carlzeith refracometer.

6- Dry weight/plant: at the end of the growing season one plant was dried at 70°C for two days.

All obtained results were statistically analysed according to Snedecor and Cochran (1967).

## 1.3 <u>RESULTS</u>

1- Plant height: Plant height of Edkawy cultivar was not greatly affected by the different treatments with the saline water (Fig.1) as compared to the other tested cultivars. In addition, the differences between the control plants and 2500 ppm were not significant. Meanwhile, E6203 plants treated with 10000 ppm gave a significant decrease in plant height than the control (Fig.1).

The cultivars, UC 82, VF 145-B 78 and Strain B, showed a moderate response as to the effect of salinity on their plant height.

2- Number of clusters/plant: The observed number of clusters/plant was 8.33, 6.67, 6.33, 5.66, 5.33 and 4.33

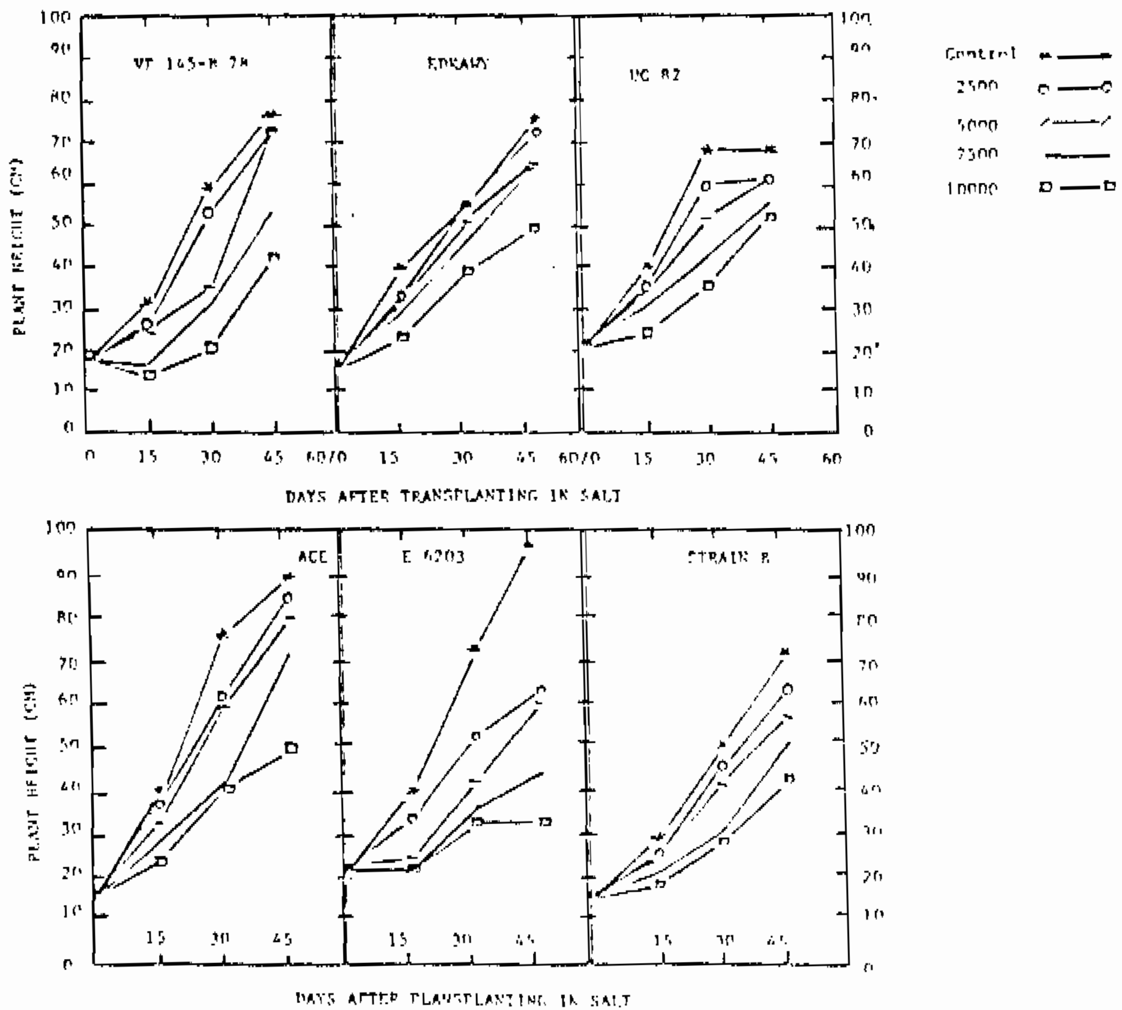


Fig. 1. Effect of valious levels of salinity on plant height for six tomato genotypes.

for E6203 , UC 82, VF 145-B 78, ACE, Edkawy and Strain B respectively .As the concentration of salt applied increased a gradual decrease for all cultivars until it reach a-maximum on 10000 ppm treated plants (Table 1).

The decrement in number of clusters/plant with the increase in salt concentration was the lowest for Ace and the highest for E6203, while Edkawy cultivar showed a midway decrement with the increase in salt concentration applied to the plants (Table 1).

3- Number Of fruits/plant : from Tabel 2, the same pattern ,as number of clusters/plant, was observed for the six tomato cultivars with the control and the increase of salt concentration in the surrounding environment of the roots, except that the decrease in fruits number per plant was more severe with the increase in salinity level.

The highest decrement was observed for VF 145-B 78 and E6203 while the lowest for Strain B and Edkawy, respectively . (Table 2).

4- Total yield/plant : A gradual decrease in total yield/plant was observed for Strain B, Ace , UC 82 and VF 145-B 78 with the increase in salt concentration from 0 ppm to 2500 ppm followed by a severe decrease up to 10000 ppm.while an opposite pattern was observed Edkawy and E6203 in the early stage and continued for E 6203 till 10000 ppm (Fig. 2 )

Edkawy gave the highest yield with increasing salinity level to 10000 ppm, while E 6203 gave no yield (Fig. 2 ).

Table (1) Effect of various levels of salinity on number of clusters/plant for six tomato genotypes.

| Genotype | Treatments | | | | | | % Reduction |
|---|---|---|---|---|---|---|---|
| | Check | 2500 | 5000 | 7500 | 10000 | Mean | |
| Strain.B. | 5.33 | 4.33 | 4.33 | 2.67 | 2.00 | 3.73 | 62.50 |
| UC 82 | 6.67 | 4.33 | 4.00 | 2.67 | 2.67 | 4.07 | 60.87 |
| VF 145-B 78 | 6.33 | 6.00 | 6.33 | 4.33 | 4.00 | 5.40 | 36.81 |
| Edkawy | 4.33 | 3.67 | 3.33 | 2.33 | 2.00 | 3.13 | 53.16 |
| Ace | 5.66 | 5.00 | 5.00 | 4.00 | 3.67 | 4.67 | 35.16 |
| E 6203 | 8.33 | 3.67 | 2.00 | 2.00 | 2.00 | 3.60 | 76.00 |
| Mean | 6.11 | 4.75 | 4.17 | 3.00 | 2.72 | | |

I L.S.D. .o5 Var.0.388
II L.S.D. .o5 Treatments 0.308
III L.S.D. .o5 Var. X treat. 0.756

Table (2) Effect of various levels of salinity on number of fruits/plant for six tomato genotypes.

| Genotype | Treatments | | | | | | % Decrease |
|---|---|---|---|---|---|---|---|
| | Zero | 2500 | 5000 | 7500 | 10000 | Mean | |
| Strain B | 3.33 | 3.33 | 2.67 | 2.33 | 2.33 | 2.80 | 30.04 |
| UC 82 | 6.00 | 3.00 | 2.67 | 2.33 | 1.00 | 3.00 | 83.33 |
| VF 145-B 78 | 3.00 | 2.33 | 2.33 | - | - | 2.55 | 100.00 |
| Edkawy | 3.33 | 3.33 | 2.00 | 1.67 | 1.67 | 2.40 | 49.84 |
| Ace | 2.67 | 2.33 | 1.67 | 1.00 | 1.00 | 1.73 | 62.54 |
| E 6203 | 6.67 | 1.00 | 1.00 | 1.00 | - | 2.42 | 100.00 |
| Mean | 4.17 | 2.55 | 2.06 | 1.67 | 1.50 | | |

I L.S.D. .o5 Var. 0.339
II L.S.D. .o5 Treatments 0.309
III L.S.D. .o5 Var X Treatments 0.757

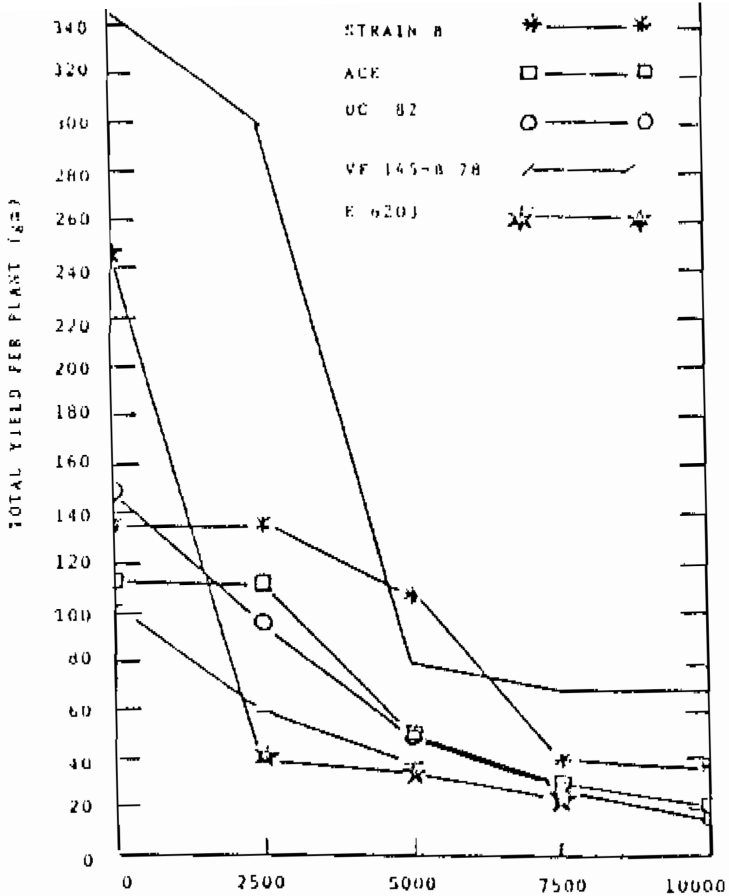


Fig. 2. Effect of various levels of salinity on total yield/plant for six tomato genotypes.

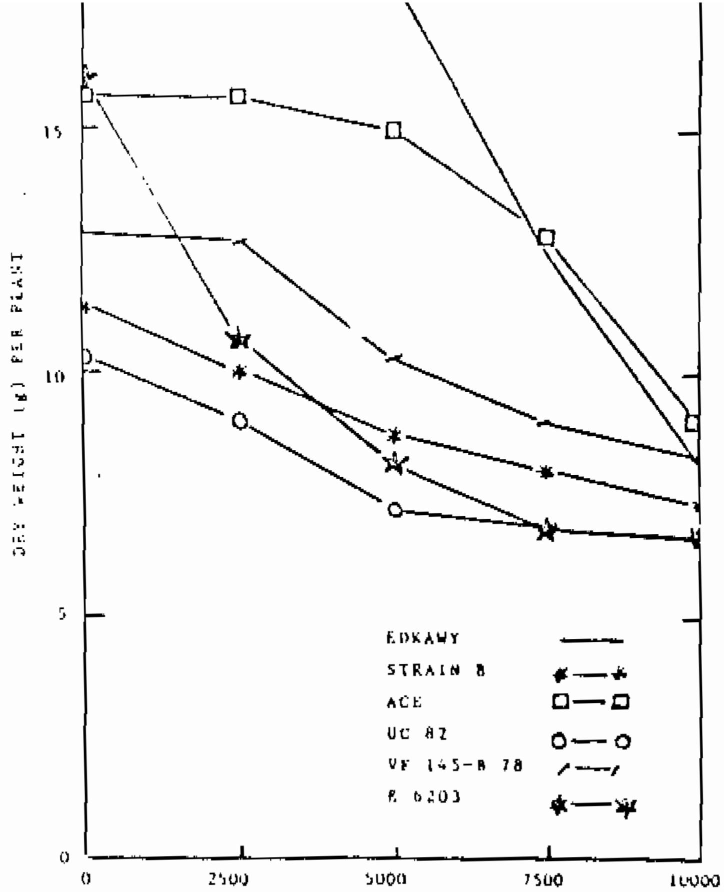


Fig. 3. Effect of various of salinity on dry weight/plant for six tomato genotypes.

5- Total solubele solids in fruits :All tested cultivars showed an increase in fruit T S S with the increase of salintiy in the surrounding environment of the roots up to 10000 ppm.

6- Dry weight/plant : increasing salinity level from 0 ppm to 10000 ppm led to a gradual decrease in dry weight/plant for Vf 145-B 78 ,Strain B and UC 82 respectively. While Edkawy showed a higher decrement from 5000 ppm up to 10000 ppm. The same pattern was observed for E6203 with the increase in salt concentration (Fig.3).

The highest value of dry weight/plant for 10000 ppm treated plants was recorded for Edkawy and the lowest for E6203.

## 1.4: DISCUSSION

The observed data of plant height are in agreement with results of Mass et. al, (1977) and Akira et al (1979) that the various genotypes of tomato showed a great variability regarding their salt tolerance.

The obtained results for number of clusters/plant confirm data obtained from Fig.1 that E6203 was the most sensitive cultivar to the increase of salt concentration in roots environment , while the reduction in number of clusters/plant of some genotypes might be explained by the results of Shannon (1978).