

**PHYSIOLOGICAL AND HISTOLOGICAL
EVALUTION OF SOME MANGO
ROOTSTOCKS**

**BY
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THESIS

**Submitted in partial fulfillment of the
Requirements for the Degree of**

DOCTOR OF PHILOSOPHY

In

**Agricultural Sciences
(Pomology)**

**Department of Pomology
Faculty of Agriculture
Cairo University
EGYPT**

2008

APPROVAL SHEET

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ACKNOWLEDGMENT

I would be honored to convey my deepest thanks and true gratitude to Dr. NABIL EL-SHERBINI, Professor of Pomology, Fac. of Agric., Cairo University, for his supervision, constructive guidance, encouragement's and continuous valuable help throughout the course of this investigation and preparation of the manuscript.

My sincere gratitude to Dr. IBRAHIM EL-SHENAWY GHOUNIM, Associate Professor of Pomology, Fac. of Agric., Cairo University, for supervision, continues advice and constructive guidance throughout the course of this study.

I am particularly grateful to my family for their helps and continuous encouragement during my study period.

Name of Candidate: Walid Mahmoud Mohamed **Degree:** Ph.D.
Title of Thesis: Physiological and histological evaluation of some mango rootstocks
Supervisors: Prof. Dr. Nabil El- Sherbini, and Dr. Ibrahim El-Shenawy Ghounim
Department: Pomology
Branch: Pomology **Approval:** 22/1/2008

ABSTRACT

This experiment was carried out during the successive growth seasons of 2003-2004 and 2004-2005 in the nursery of Agriculture Development System (A.D.S), Faculty of Agriculture, Cairo University, Giza Governorate, Egypt.

The study aimed to evaluate the resistance the seedlings of some mango strains (Sukkary, Zebda, Ewais and Alphons) as a rootstocks for stress by sodium chloride. Also, the experiment aimed to study the evaluate of two scions (Tommy atkis and Keitt) grafted on four mango rootstocks.

Results indicated that the low salt concentrations (control and 1000 ppm) increased significantly plant growth (number of leaves per plant, plant height, number of roots, root length, leaf area per plant, survival percentage, fresh and dry weight) followed by 2000 ppm with Sukkary and Zebda rootstocks in both seasons. While the lowest plant growth was recorded with high salt concentrations (3000 and 4000 ppm). On the contrary, the highest number of shoots was obtained with high salt concentrations (3000 and 4000 ppm with Sukkary rootstock. These results were statistically significant in both seasons. The results reported that chemicals contents (Na, Cl, proline, and total phenol) increased with high salts concentrations (3000 and 4000 ppm), whereas K and total sugar content in leaves decreased with increasing salts concentrations. Salinity treatments generally caused reduction in the measurements and counts of the following leaf histological traits. Thickness of upper epidermis, thickness of lower epidermis, palisade chlorenchyma cells, length and width of vascular bundles. In grafting experiment, growth parameters (number of shoots, number of leaves and survival percentage) increased with Tommy atkins variety, while the plant height increased with Keitt variety, also increased with Sukkary and Zebda rootstocks in comparison with other rootstocks. The results indicated that total sugar content increased with Tommy atkins variety, while total phenol content increased with Keitt variety. Total sugar and total phenol content was increased with Ewais and Alphons rootstocks. Tommy atkins and Ewais rootstock gave the higher survival percentage and caused or led to increased sugar and decreased phenol due to success grafting process.

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INTRODUCTION

Mango, *Mangifera indica* L. is one of the most important foreign currency earning fruit crop is a member of the family Anacardiaceae. It is known as the "King of fruits". The mango is nutritionally rich in carbohydrates and vitamin A and C. It is relished and liked by every one for its flavor and dietetic value and is also claimed to be of medicinal value. For instance, chutney made from the green (unripe) fruit is considered to be an effective antidote for mild forms of sunstroke. Apart from this, unique mango recipe such as mango ice cream, mango milk shakes, mango squashes etc. are favorite desserts. Mango juice, jelly, marmalade, pickles etc. are also commonly consumed (Mithal , 2002).

The area cultivated with mangoes in Egypt, increased annually to face the augment of mango exportation, this area estimated by 151857 fedans (the fruiting area is 110336 fedans), while the total mango production was 596758 tones, according to the Ministry of Agriculture in Egypt (2006).

Soil salinity is one of the main agricultural problems in Egypt. The symptoms of transient salinity stress are leaf tip and side burn followed by leaf drop. If new shoots do not develop from the affected regions, branch die-back will occur. Severe and regular stress results in tree decline. Trees that lose their leaves also lose their ability to flower. Stunted growth of terminal shoots elicited by very short internodes and small leaves is a sign of prolonged and general stress. Rootstocks and

scions differ vastly in their ability to tolerate stress. In an orchard planted on Balladi, it is not uncommon to see trees that do not suffer stress, and trees that do, under the same orchard conditions. (HortResearch SA, 2001).

This research aimed to evaluate the salinity resistance of some mango seedling strains (Sukkary, Zebda, Ewais and Alphons) as a rootstocks. We also studied the effect of the four rootstocks on some vegetative characteristics of two grafted varieties, Tommy atkins and Keitt.

REVIEW OF LITERATURE

The available literature dealing with the effect of salinity on growth parameters and chemical contents of mango plants, also the effect of salinity on such parameters for some other fruit species, are included under the following topics:

1. Effect of different salts concentrations on mango.

a. Salt tolerance of fruit species:

Regarding the effect of isosmotic solutions of various salts, there are two opposite opinions: the first is that the osmotic solutions are known to cause similar reduction in growth (Bernstein and Hayward, 1958); the second is that the osmotic solutions do not always affect the plant equally (Sharma, 1973).

Jindal *et al.* (1976) found that the various cultivars of mango grown under high salinity levels absorbed concentrations of Na, Cl and SO_4 in toxic amounts which adversely affected the growth and nutrient balance

Polyembryonic rootstock '13-1' has been demonstrated to tolerate calcareous soil containing 200/g CaCO_3 and saline irrigation water containing over 600 ppm chloride (Kadman *et al.*, 1978).

Gazit and Kadman (1980) were able to grow 'Maya' mango on '13-1' rootstock on calcareous soils with up to 20 % lime and 250 ppm chloride. In addition, 'Ann' and 'Gomera' polyembryonic rootstocks also show salt-tolerance (Galan Sauco, 1993).

Ayers (1977) found that specific ions at relatively low concentrations have a direct toxic effect on growth on sensitive crops. The toxic includes mainly boron, chloride and sodium. Guide lines of

interpretation of quality of water for irrigation indicated that there was no problem when EC or irrigation water was <0.75 mmhos/cm. The problem always initiate when EC value reached about 0.75-3.5 mmhos/cm and severe problems took place when EC value was >3.5 mmhos/cm.

Many authors were interested in exploring the mechanism of salt injury in different plants (Bernstein, 1975 and Miller *et al.*, 1990). They explained the adverse effects of salinity on plant growth on the following two topics:

- 1- The increase in the osmotic potential of the soil, which certainly result in reduction in the availability of water to the plant.

- 2- The specific toxic effect of some ions, such as Cl, Na and B especially it, the certain sensitive crops, consequently caused a disturbance in the normal metabolism of plants.

As reported by GreenWay and Munns (1980) indicated that salt tolerant plants are generally thought to be protected from salt stress by either ion accumulation or ion exclusion. Accumulation of high concentration of ions in halophyte leaves has been known to be a salt tolerance mechanism. Salts can be tolerated because ions are compartmentalized in the vacuole and not in the cytoplasm. Hence, metabolic processes are not inhibited. These ions in the vacuoles balanced with natural organic solutes in the cytoplasm lower the leaf osmotic potential. This allows the plant to extract water from saline solutions.

According to Levitt (1980) there are two possible mechanisms of plant tolerant to salinity one the excretion of the absorbed salt into the

vacuole, and the other one is the plant may be able to tolerate the ion-balance strain.

Schmutz and Ludders (1994) found that the mango rootstocks 13-1 and Turpentine, shown to be salt-tolerance and salt-susceptible, respectively, in the field, were grown in controlled conditions with nutrient solution which was made increasingly saline from day 11 (15 mM NaCl added) to day 22 (120 mM NaCl added). After 29 days of NaCl treatment, leaf Na and Cl concentrations were higher in 13-1 than in Turpentine.

DuranZuazo *et al.* (2002) found that the impact of saline irrigation water of different chloride and sodium concentrations on the fruit yield of field-grown mango (*Mangifera indica* L. cv. 'Osteen') was evaluated for 4 years (1996-1999). Tree performance was evaluated for two rootstocks (Gomera-1 or Gomera-3) and at water salinities' having an electrical conductivity of 1.02, 1.50, 2.00 or 2.50 mmhos/cm. The results demonstrated that Gomera-1 was slightly more tolerant to salinity than Gomera-3. The sensitivity of Gomera-3 was reflected in smaller fruit and lower yield in the most saline treatments. In addition, chloride and sodium concentrations in leaves and fruits were higher in the trees with Gomera-3.

b. Effect of salinity on plant growth:

Jindal *et al.* (1976) reported that, high soil salinity levels adversely affected mango tree growth. Leaf injuries increased with salt concentration, and at 10 mmhos/cm almost all the leaves were injured, seedling mortality began at 4 grafted cultivars of mango are more sensitive to salinity than the ungrafted ones.

Kadman *et al.* (1978) selected mango cv. 13-1 or its relatives as the most tolerant variety among 80 varieties tested. They also found that seedlings planted in sandy soil containing 10-15% Ca CO₃ and drip irrigation with water containing over 600 ppm Cl, rapidly developed leaf scorch and symptoms of Fe deficiency, but in the mentioned variety, the damage was nil or very slight.

Jindal *et al.* (1979) pointed out that the mango tree was doing well over a PH range from 5.5 to 7.5 but it was not tolerant to salinity.

Gazit and Kadman (1980) added that three mango cultivars on 13-1 rootstock showed good development on sandy soil with 10-20% lime and irrigated water containing 250 ppm Cl. This rootstock though propagated by seed, almost all progeny being identical with the mother tree.

Abd El-Karim (1991) in a study on four mango cultivars namely: Hindy Besinara, shamptan, Zebda and Taymour with tap water contained different concentrations of chloride salts of Na, Ca and Mg at the ratio of 3NaCl:1(3CaCl₂: 1MgCl₂) at 1000 to 4000 ppm a mixture decreased plant height, stem thickness, total number of leaves and average leaf area proportionally to the increase in salts concentration in irrigation water. Also, he found that a general decrease in leaves dry matter content, stem and root of mango seedlings with increasing salts concentration of irrigation water.

Schmutz *et al.* (1993) found that the mango rootstock 13/1 has relatively high salt tolerance under field conditions, but the mechanism of this tolerance is not known. The morphological and physiological responses of this cultivar to increasing salt stress were studied using 0,