5. Summary and Conclusion

Salinity is a serious problem throughout the world, and particularly in newly reclaimed areas in Egypt, restricting agricultural productivity and degrading the natural environment. Sensitivity of plants to salinity can vary from one stage of growth to another. Differences exist between tomato accessions and *Lycopersicon* species in their tolerance to salinity. Since some wild species can be crossed with the cultivated tomato, they represent possible source of salt tolerance that could be exploited by interspecific hybridisation. The objective of this study is to describe how some progress may be made toward obtaining plants with enhanced salt tolerance by measuring the theoretical aspects of breeding plants for salt tolerance with the present knowledge concerning the effects and mechanisms of salt stress.

Castlerock is by far the most extensively grown tomato cultivar at present in Egypt. Edkawy is considered as relatively salt-tolerant. Three experiments were carried out at the Agricultural Experiment Station, College of Agriculture, Cairo university in Fayoum, during the summer seasons of 1993 and 1994 to characterize their response to changed salinity levels at different stages of growth; seed germination stage, seedling establishment stage and post-transplanting stage:

A pot experiment was carried out during the fall seasons of 1993 and 1994 in an effort to develop an easy evaluation method for salinity tolerance in the seedling stage. Genotypes evaluated comprised two *L. esculentum* accessions, viz., Castlerock and Edkawy and three *L. pimpinellifolium* accessions; LA 1579, PI 344102, and PI 344103.

Genetic studies: Seeds of F_1 and F_2 populations of the following 7 crosses produced during the period from 1993 through 1995. Edkawy x LA1579, Edkawy x PI 344102, Edkawy x PI 344103, Castlerock x Edkawy, Castlerock x LA 1579, Castlerock x PI 344102, and Castlerock x PI 344103. The various genetic populations were evaluated for salt tolerance during the 1996 late summer planting. A randomised complete block design (RCBD) with three replications was used. Data were recorded daily on the number of surviving plants.

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At the seed germination stage, Castlerock and Edkawy responded in a similar qualitative fashion to the inclusion of salinity to the germination media. However, the magnitude of responses varied between the two cultivars. Overall comparisons indicated significant differences between the two cultivars in germination percent, relative germination percent, germination rate as well as germination rate index. Across all treatment, germination percent and relative germination percent decreased as salinity level increased, while germination rate and germination rate index increased. These results revealed that a genotype that germinated rapidly at high salinity levels was not necessarily tended to germinate rapidly at low salinity levels.

At the seedling establishment stage and the post-transplanting stage survival percent was decreased as salinity level increased. The interactions of accession by salinity, accession by time interval, salinity level by time interval, and accession by salinity level by time interval were significant in both years. The general trend was consistent, at all salinity levels and/or time intervals, Edkawy exhibited higher seedlings survival percent than Castlerock. The considerable variation found between the two accessions in their responses to salinity at the seedling establishment stage and at the post-transplanting stage indicated that it should be possible to select tolerant accessions for plant survival under saline condition, with fresh water applied for seedlings establishment.

Highly significant differences in dry weight of the various plant parts were evident in response to salinity. Differences in dry weight of the various plant parts in response to salinity, were genotype dependent. Edkawy seemed more salt tolerant than Castlerock and the wild species. As salinity level increased, LDW, SDW, and RDW became more affected. Stem was generally more inhibited in growth than roots and at low salinity levels roots growth was not decreased significantly. The reason(s) for the inhibited growth may be due to the difficulty for plants to withdraw water from the soil, even the soil was quite moist. In effect, the plants suffered from a form of drought which retarded growth. The current results indicated significant differences in salt tolerance between species as well as among accessions of a species as evident by the rate of inhibition in LDW, SDW and RDW. Thus the current results can be used as a general guide but further information must be obtained.

Like dry weight, relative dry weight, across all treatment, decreased as salinity level increased. Differences in relative dry weight were genotype dependent. Edkawy attained the highest relative dry weigh, while Castlerock achieved the least relative dry weight. PI 344102, LA 1579 and PI 344103 was intermediate between Edkawy and Castlerock.

Results of the comparison at 50% RSDW, RLDW and RRDW reduction and comparison based on slope values did not coincide with each other. Moreover, comparison based on slope values did not coincide with different plant parts. To the contrary, comparison at 50% RSDW, RLDW and RRDW reduction were consistent. Therefore comparison at 50% RSDW, RLDW and/or RRDW could be used without great loss of accuracy in *Lycopersicon* salt tolerance evaluation programs.

Potassium concentration in all plant parts and among all accessions was inversely related to salinity levels. Among accessions of *L. pimpinellifolium*, LA 1579 had the highest K concentration followed by PI 344102 and PI 344103, respectively. Within the *L. esculentum* accessions, Edkawy differed considerably from Castlerock in K concentration and in response to salinity. The pattern of K distribution in all accessions did not differ; the highest concentration was found in the leaves while the least concentration was found in the roots.

Potassium concentrations in leaves, stems and roots were significantly correlated with LDW, SDW, RDW, RLDW, RSDW, and RRDW. Similarly, K concentration in leaves, stems and roots were significantly correlated with each other.

Across all treatments, Na and Cl concentrations increased progressively as salinity level increased. The *L. pimpinellifolium* accessions absorbed larger amounts of Na and Cl than did the domestic *L. esculentum* accessions. Among accessions of *L. pimpinellifolium*, PI 344103 had the highest Na and Cl concentration followed by PI 344102 and LA 1579, respectively. Within the *L. esculentum* accessions, Edkawy had higher Na and Cl concentration than Castlerock. As plant parts are considered, roots had the highest Na and Cl concentration followed by leaves and stems, respectively.

Sodium and chloride concentrations in leaves, stems, and roots were negatively correlated with LDW, SDW, RDW, while positively correlated with RLDW, RSDW, and RRDW. Likewise, Na and Cl concentration in leaves, stems and roots were significantly correlated with each other. As expected, Na and Cl concentrations in leaves, stems and roots were negatively correlated with K concentration, while Cl and Na concentrations in all plant parts were positively correlated.

As salinity level increased, KRCI decreased progressively. The salinity-induced reduction in KRCI was most pronounced in the sensitive accession; Castlerock relative to Edkawy or to any of the other wild species. Differences among accessions of the same species were significant. As plant parts are considered, leaves had the highest KRCI followed by stems and roots. Potassium RCI in leaves, stems and roots were significantly correlated with LDW, SDW, RDW, RLDW, RSDW, and RRDW. On the same hand, KRCI in leaves, stems and roots were significantly correlated with each other.

Across all treatments, as salinity level increased, NaRCI increased progressively. Differences between species and among accessions of the same species were significant. In general, accessions of *L. pimpinellifolium* had larger NaRCI than did the domestic accessions of *L. esculentum*. Among accessions of *L. pimpinellifolium*, PI 344103 had the highest NaRCI followed by PI 344102 and LA 1579, respectively. Within the *L. esculentum* accessions, Edkawy had higher NaRCI than Castlerock. As plant parts are considered, stems had the highest NaRCI followed by roots and leaves, respectively.

Sodium RCI in leaves, stems and roots were negatively correlated with LDW, SDW, RDW, while positively correlated with RLDW, RSDW, and RRDW. On the same hand, NaRCI in leaves, stems and roots were significantly correlated with each other. Nonetheless, NaRCI and KRCI in leaves, stems and roots were negatively correlated with each other.

Across all treatments, as salinity level increased, ClRCl increased progressively. Differences between species and among accessions of the same species were significant. In general, accessions of *L. pimpinellifolium* had larger ClRCl than did the domestic accessions of *L. esculentum*. Among accessions of *L. pimpinellifolium*, LA 1579 and PI 344103 had higher concentration than PI 344102 in 1993 while PI 344102 and PI 344103 had higher concentration than LA 1579 in 1994, respectively. Within the *L. esculentum* accessions, Edkawy had higher ClRCl than Castlerock. As plant parts are considered, roots had the highest ClRCl followed by leaves and stems, respectively.

Chloride RCl in leaves, stems and roots were negatively correlated with LDW, SDW, RDW, while positively correlated with RLDW, RSDW, and RRDW in both years. On the same hand, ClRCl in leaves, stems and roots were significantly correlated with each other. Nonetheless, ClRCl and KRCl concentrations in leaves, stems and roots were negatively correlated while ClRCl and NaRCl in all plant parts were positively correlated. Moreover, ClRCl and KRCl were highly and negatively correlated while ClRCl and NaRCl were positively correlated.

Across all treatments, K: Cl ratio decreased progressively as salinity level increased. Among accessions of *L. pimpinellifolium*, LA 1579 had the highest K: Cl ratio followed by PI 344102 and PI 344103, respectively. Within the *L. esculentum* accessions, Edkawy had higher K: Cl ratio than Castlerock. Plant parts varied in K: Cl ratio; stems had the highest K: Cl ratio followed by leaves and roots, respectively. Collectively, results showed that K: Cl ratios and LDW, SDW and RDW were highly correlated.

Across all treatments, K: Na ratio decreased progressively as salinity level increased. Among accessions of *L. pimpinellifolium*, LA 1579 had the highest K: Na ratio followed by PI 344102 and PI 344103, respectively. Within the *L. esculentum* accessions, Edkawy had higher K: Na ratio than Castlerock. The same trend was similar in both years. Plant parts varied in K: Na ratio; stems had the highest K: Na ratio followed by leaves and roots, respectively.

Across all treatments, Na: Cl ratio decreased progressively as salinity level increased. Among accessions of *L. pimpinellifolium*, PI 344103 had the highest Na: Cl ratio followed by PI 344102 and LA 1579, respectively. Within the *L. esculentum* accessions, Castlerock had higher Na: Cl ratio than Edkawy. Plant parts varied in Na: Cl ratio; stems had the highest Na: Cl ratio followed by leaves and roots, respectively.

Statistical analysis of the data obtained on percentage of surviving plants in different genetic populations of the various crosses revealed no significant differences among replicates. Heterosis, based on both mid-parent and high parent values, were calculated for each cross. These studies demonstrate a genetic component of salt tolerance that can be transferred through selection and breeding and that improved tolerance of salinity is biologically feasible. While these selections lack the desirable traits of domestic cultivars, they provide evidence that substantially improved performance under the stresses of saline environments can be achieved. It is hoped that the germplasm now at hand can be used for the development of salt tolerant cultivars. Finally, related genotypes differing in salt tolerance, offer the opportunity for research on the mechanisms of salt tolerance and its genetic control.