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Yeast as a Molecular Genetic System for Improvement of Plant Salt Tolerance*

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I. INTRODUCTION

A. Salinity: An Impediment to Crop Production

The detrimental impact of salinity on plants (mainly Na^+ salts) remains a major limitation to crop production in arid, semi-arid, and irrigated agriculture. Salt is estimated to negatively impact approximately 950 million ha, about 6 percent of the world's land surface (Flowers and Yeo 1995). Currently, 45 million ha (19.5%) of the 230 million ha of irrigated land and 32 million ha (2.1%) of the 1500 million ha of dry land used for agriculture are affected by salt (FAO AGL 2000). Primary salinization is caused by the accumulation of salt in areas where the amount of evapotranspiration exceeds the amount of precipitation, particularly in arid or semi-arid regions. Secondary salinization/alkalization is a consequence of agricultural practices that facilitate net accumulation of salts in the plant root zone; typically, the use of salt-containing irrigation water, or irrigation of soils without adequate drainage (Epstein et al. 1980; Brady 1984). It is estimated that 3 ha of arable land are lost every minute due to soil salinity (FAO AGL 2000).

Appropriate agricultural management practices can maintain or improve crop productivity on salt affected soils. These practices include reducing salt in the root zone by under drainage or leaching of soil with high quality irrigation water, converting alkali carbonates to sulfates by the application of gypsum, and retarding evaporation of water from the soil to reduce movement of salts to the soil surface (Brady 1984). However, implementation of these practices is time-consuming and expensive, and often not possible. Furthermore, these practices cannot alleviate conditions of more extreme salinity. Recently, great emphasis has been directed toward the development of salt tolerant cultivars. Tolerant plants would complement irrigation practices that reduce soil salinity as these plants would not require the excessive amount of water that is often necessary to reduce salt levels to acceptable limits in the soil for crop growth (Flowers and Yeo 1995).

Plant breeding has facilitated modest gains in yield stability under stress environments through genetic introgression from wild salt toler-