Transgenic plants

Environment, Water

Introduction For the past 30 years Scientist have searched desperately for the answer to salt toleration within plants. The damaging effects of salt accumulation in agricultural soils have influenced both ancient and modern day civilizations alike. Worldwide, an estimated 24. 7 million acres of once agriculturally productive land are being lost annually due to irrigation-induced salinity, according to the U. S. Department of Agriculture. Thus, crop production is limited by salinity on 40% of the worlds irrigated land and on 25% of the irrigated land in the United States. These statistics indicate that the progressive loss of farmable land is on a crash course with the expanding global population, in that if something is not done to revamp the output of crop production with in the next 30 years, we will bare witness to the first world wide foot shortage in history. To solve the salt tolerance crisis, scientists have turned to genetics, an area that has been very beneficial to the Agricultural industry in the past century. In fact, thanks to the implication of genetics in the 1960’s the yield per acre of many major crop plants has doubled. This dramatic breakthrough is known as the “ Green Revolution". As a result of the Green Revolution, countries of western Europe, who used to be the worlds largest importer of food, have become self sufficient. The genetic improvement of crops worldwide played a substantial role in the recent decline in the balance of American trade. While the Green Revolution doubled the output of crops across the world, Eduardo Blumwald’s work in the field of salt tolerance may in fact be the mother of all agricultural breakthroughs even bigger than the Green Revolution. Here’s why. In order to maintain the current crop output, farmers must constantly irrigate their land. The irrigation process increases the salinity of soils and water by

depositing soluble salts such as Sodium, calcium, magnesium, potassium, sulfate, and chloride that the water picks up from the soils and rocks that it has passed through. As the irrigation process is repeated, the irrigated soils accumulate salt, at levels that decrease the productivity of the crops grown there. The salt in irrigation water can prevent plants from taking in needed water through their roots, this blockage in turn leads to the death of the plant in question. In hopes overcoming the severe salt burden, Eduardo Brumwald has genetically engineered a tomato plant that can in fact grow, flower, and produce fruit in salt concentrations there were 50 times higher than normal. Brumwald accomplished the feat by manipulating a single gene, after several other researchers gave up, believing that in order to breed salt tolerant crops one would have to manipulate a pyramid of genes. The gene Brumwald manipulated was AtNHX1, a vacuolar Na/H antiport from Arabidopsis thaliana. The gene is responsible for producing higher levels of naturally occurring transport proteins. With the new gene in place, the transgenic tomato plant uses transport proteins to pump sodium from the cytoplasm to vacuoles where the salt is then stored. The significance of the genetically engineered plant is that it stores the newly absorbed salt in its leaves rather then in the fruit, thus enabling it to produce a quality crop under sub par conditions. As if being able to grow a crop at a 50 times the normal salt concentration were not enough, Brumwalds new break through brings another interesting aspect to the agricultural table. The new transgenic salt tolerant plants can not only produce fruit in salty soil but at the same time the crops will heal the once barren land by absorbing the salt into its leaves. It is for this reason that this agricultural break through is so

important. Now that you have heard what the new salt tolerant transgenic plants can do let me tell you a little about the experiments conducted and the procedures taken to accomplish this great feat. For the salt tolerance experiments, wild-type and two transgenic plants were grown hydroponically. The seeds were germinated in agar plates containing MS medium at 25 degrees Celsius. Two weeks after germination, 60 of each wild-type and transgenic seedlings were transferred to 6 hydroponic tanks and grown in the green house with temperatures conducive to good growth. Three months later a chemical analysis was conducted on the plants. Here are the results: In conclusion I feel that Brumwalds salt-tolerance breakthrough should be recognized as one of the greatest agricultural achievements of the century. He accomplished what many had deemed impossible. The possibilities are endless. Talks of salt water irrigation have already begun and Brumwald believes that with the proper funding, it would be possible to develop commercially useful salt tolerant tomato plants within three years.