Scientists discover genetic factor that makes barley plants resistant to salt

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Barley breeders may soon develop varieties of barley which are both less sensitive to high concentrations of salt ions in the plant and more resistant to osmotic stress caused by saline soil. Nguyen Viet Long, who hopes to obtain his doctorateat Wageningen University (part of Wageningen UR) on 2 November 2012, has found two sequence regions in the chromosomes of barley that contain the genes for these two properties. The section comprising resistance to osmotic stress in particular is receiving a great deal of international attention from scientists working on salt tolerance. Nguyen is hoping that barley varieties which can be cultivated in saline soils will reach the market within around five years, thanks in part to his results.

Salinisation of agricultural land is a global problem. An area two hundred times the size of the Netherlands has already become too saline to use for food production. One fifth of this represents some of the best irrigated farmlands in the world. And climate change is aggravating the problem even further.

This is why researchers and plant breeders around the world are looking for opportunities to develop salt-tolerant crops for arable farming and horticulture. Of course this mostly focuses on the major food crops such as grains and potatoes. The Vietnamese PhD student Nguyen examined the possibility of adapting barley to saline conditions. Since barley is a grain, many of the results of this research will be useful to scientists studying wheat or rice.

Nguyen worked together with the Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK) in Germany, which has a large collection of different varieties of barley. Nguyen examined some two hundred different varieties, including barley types from the Middle East. This is the area where barley originated, which means that large genetic variation can be found there – and the greater the genetic variation of examined varieties, the higher the chance of finding genetic factors that can be used in plant breeding. Being able to investigate so many different types of barley enabled Nguyen to determine the positions of the important hereditary properties faster and more accurately.

In his research, Nguyen studied the growth of barley plants in high salt conditions. He looked at a number of plant characteristics that are important for salt tolerance such as delayed yellowing of leaves, number of shoots and ion content in the leaves. By linking these observations to DNA analysis, he found two positions in the barley genome that affect the plant's resistance to salt.

One of the two areas, on chromosome 4, affects how the plant deals with increased concentrations of salt ions such as Na^+ and Cl^-. The plant uses a kind of 'ion pump' to prevent these elevated ion concentrations from reaching the leaves. This allows the photosynthesis in the leaves to continue as normal, permitting the plant to continue growing and producing seeds. The discovery of a similar mechanism in wheat was in the news quite recently.

The second area identified by Nguyen, on chromosome 6, contains one or more genes that make barley plants less sensitive to osmotic stress, which is the result of the high concentration of ions in saline soil. In this situation, plants absorb water less easily, which directly affects growth of the plants. This discovery is a real breakthrough, and has led to considerable international interest. The precise genes responsible for salt tolerance in barley will probably be identified soon. "Examining the genetic makeup and salt tolerance of so many different types of barley enabled me to map the interesting areas quickly and accurately," Nguyen explains. "I am therefore hopeful that we will have barley varieties that can be grown on saline soils within around five years "

Provided by Wageningen University

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