ملخص المشروع

"Improving the water use efficiency of rice by differential regulation of aquaporin genes".

الباحث الرئيسي للمشروع البحثي:

أ.م.د. جابر مختار ابو جادالله أستاذ مساعد بقسم النبات – كلية العلوم – جامعة دمياط

الفريق البحثي:

1- د. ريهام محمد ندا مدرس بقسم النبات- كلية العلوم – جامعة دمياط
2- سلوان عبد الحكم حسن مدرس مساعد بقسم النبات- كلية العلوم – جامعة دمياط
3- نسمة محمد رضا القشلان معيد بقسم النبات- كلية العلوم – جامعة دمياط

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About the project

Rice is one of the most important crops in the world. It is also the second most important crop in Egypt. However, it is the most water consumer among all crop plants. In view of the changing climate and the limited water resources, rice production seems to be under threat. Such a situation would render more proportions of the world population vulnerable to malnutrition. One approach to tackle this problem is to develop rice genotypes with higher water use efficiency (WUE) (i.e., consumes less water without loss of productivity) and with acceptable yield under conditions of water shortage. The primary aim of this work is to improve the WUE, drought tolerance and grain yield of rice by differential regulation of aquaporin genes.

A thorough survey and analysis of the published data indicates that the low WUE and drought tolerance of rice is largely the result of low hydraulic conductance of rice roots combined with high rates of transpiration. As a result, the plant suffers from midday stomatal depression (decrease in stomatal conductance and rate of photosynthesis) when the light intensity and temperature reach maxima, even in submerged soil. Midday stomatal depression is often accompanied by xylem cavitation. To revert xylem cavitation and hence restore normal photosynthesis, the plant needs to go through night time with high soil water availability to allow root pressure to develop and thereby re-fill the cavitated xylem vessels. This necessitates that rice fields be submerged with water at least once at the end of every day. If not reverted, xylem cavitation would bring about long term reduction in the rate of photosynthesis and ultimately reduces plant growth and grain yield.

Analysis of the published data from comparative studies involving rice genotypes with different capabilities of drought tolerance and WUE as well as other species indicates that the low hydraulic conductance of rice roots is linked to low levels of expression of the aquaporin genes. Combined with high rates of transpiration, this situation renders rice plant very sensitive to water shortage and also reduces its WUE under conditions of high water availability. A detailed analysis of the available data is presented in the Background section.

We hypothesized that over expression of some selected root-specific aquaporin genes as well as under expression of leaf-specific aquaporin genes in rice would balance the water status of this important crop plant and thus, help maintain higher rates of photosynthesis during the day (reduce or avoid midday stomatal depression). This in turn would improve the field performance and

grain yield of rice under normal and stressful conditions. The bases of our hypothesis are explained in the background section. The proposed work aims at developing rice genotypes with improved WUE, drought tolerance and grain yield by overexpression of root-specific aquaporin genes and/or under expression of leaf-specific aquaporin genes.

Project outcomes

1- **Part of the data has been published in Plant Science [Reham M Nada, Gaber M. Abogadallah: Aquaporins are major determinants of water use efficiency of rice plants in the field. Plant Science (2014)227 165–180].**
2- **Establishing a well-equipped laboratory for plant functional genomics with some of the latest technologies of plant biology research.**
3- **Introducing young researchers to the basic and advanced tools of plant biology research.**