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Fructans in wheat under stress conditions

Ildikó Kerepesi[1]*, Éva Bányai-Stefanovits[2], Gábor Galiba[3]

[1]Department of Genetic and Molecular Biology, University of Pécs, Pécs, Hungary, [2]Department of Applied Chemistry, Szent István University, Budapest, Hungary, [3]Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvásár, Hungary

Water deficit associated with salinity in irrigation water is the major limiting factor to crop yield in many regions of the world. In addition to its role as a reserve carbohydrate, fructan appears to be advantageous for plans under unfavourable conditions (Housley and Pollock 1993; Kerepesi and Galiba 2000).

In this study we attempt to assess and characterise the involvement of water-soluble carbohydrates and especially fructan content in the adaptive processes of various wheat genotypes under consecutive drought and salt stresses. More precisely, our purpose was to distinguish between the effects of non-ionic (PEG) and ionic (salinity) osmotic stress conditions on fructan content in different parts of plants and to describe the degree of salt and drought tolerance on the basis of changes in concentration of fructan in wheat seedlings.

Materials and Methods

Hydroponically-grown 3 week-old wheat (*Triticum aestivum* L.) seedlings were exposed to water stress (18% PEG) for 7 days and salinity (200mM NaCl) for 4 days (Nagy and Galiba 1995). The varieties were chosen because of their known response to drought and salinity: Sakha-8 (S) is regarded as drought and salt tolerant, Kobomugi (K) as drought tolerant and salt sensitive, Chinese Spring (Ch) as moderately drought and salt tolerant and Regina (R) as drought and salt sensitive. Samples of stems (crown plus whorl), leaves and roots were taken on the 2nd, 7th, 11th day of experiment for measurement of fructan content. (Kerepesi et al. 1996).

Results and Discussion

Fructan concentration in stems and leaves increased significantly (Fig. 1A,B) after seven days of PEG treatment in all varieties. The highest fructan level was measured in leaves and showed positive correlation with the degree of drought tolerance of varieties. In roots (Fig. 1C) PEG treatment decreased fructan concentration at the second day followed by an increasing trend at seventh day.

Changes in fructan content of seedlings following the transfer from PEG to a NaCl medium in stems was positively correlated with the degree of salt tolerance (Fig. 1A). Fructan in the salt resistant (Sa) and moderately tolerant (Ch) varieties, increased, while fructan content decreased in the sensitive varieties (Ko, Re). If a lower fructan content is the result of the salt treatment, then Kobomugi should be considered more sensitive to salt than Regina. This result is in agreement with the classification of cultivars of Nagy and Galiba (1995), based on the measurements of photosynthesis and abscisic acid concentration under similar experimental

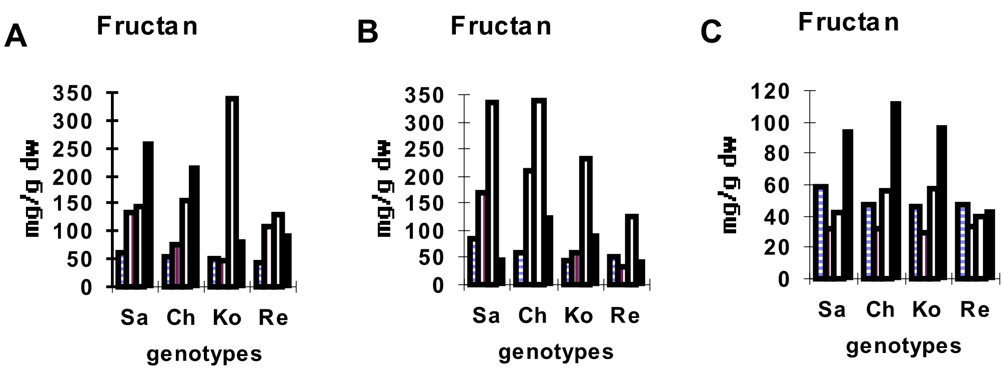

Figure1. Fructan content in stems (A), leaves (B) and roots (C) of wheat seedling, grown in 18% PEG treated culture solution until day 7 and then transferred to equi-osmolar 200mM NaCl solution until day 11. The bars are from left to right: Control (0 day); PEG 2nd day; PEG 7th day; NaCl 11th day. Symbols: Sa: Sakha; Ch: Chinese Spring; Ko: Kobomugi; Re: Regina.

*Corresponding author. E-mail: ilda@ttk.pte.hu

conditions. In leaves of all four varieties a sharply decreasing fructan level was detected (fig. 1B). At the same time fructan accumulation in roots (fig. 1C) increased significantly, except Re, which had similar fructan concentration in both ionic and non-ionic stresses.

For a possible explanation of the differences found between the organs it is important to emphasise that fructan synthesis in the leaves is based on photosynthetic sucrose synthesis (SST), while that in the stems and roots as non-photosynthetic tissues reflects the translocated and subsequent metabolism (Housley and Pollock 1993).

The different behaviour of the two salt sensitive varieties may be explained on the basis of their different drought tolerance. In the case of salt stress subsequent to drought, the "waste use of water" syndrome in drought tolerant varieties may lead to an abrupt and large increase in water and possibly to an ion uptake.

The high drought induced fructan accumulation despite of the inhibiting effect of salinity is in agreement with Hendry's opinion that the evolutionary significance of fructan was an adaptation to drought.

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