Physiological phenotyping of a sorghum mapping population for seedling chilling tolerance

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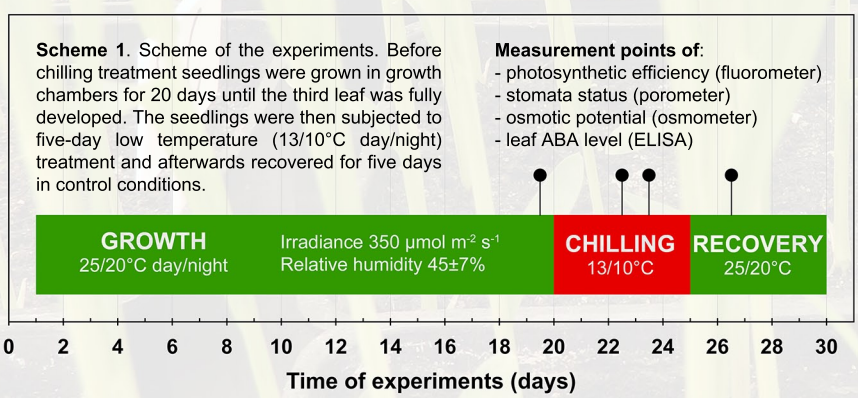
INTRODUCTION

In view of the effects of global climate changes on plant growth conditions in Europe, specific traits of sorghum (*Sorghum bicolor* (L.) Moench) make some of its cultivars (sweet sorghum) a promising candidate for a future bioenergy crop in this region. The main limiting factor seems to be low tolerance of sorghum seedlings to low temperature and possible seedling damage caused by cold spells occurring in April and May. However, thanks to very broad genetic variability of this trait in the sorghum species, it should be possible to breed new hybrids aiming at higher chilling tolerance.

The aim of the presented research is physiological characterization of a mapping population of 176 lines and their parental lines Ji-2731 and Etian (JxE) at the seedling stage under chilling and recovery conditions, aiming at the identification of potential traits differentiating the genotypes' responses to chilling stress.

MATERIALS AND METHODS

For each line 3 pots – each with 13 planted seeds – were set up in growth rooms. After growing for 20 days under 25/20°C (day/night) the seedlings at the 3rd leaf stage were exposed to five-day chilling (13/10°C, day/night) and then recovered for five days at control temperature. Directly before and during the chilling treatment as well as during recovery the following physiological parameters were measured for the 1st, 2nd, and 3rd leaf: photosynthetic efficiency as chlorophyll *a* fluorescence, stomata status by porometer, osmotic potential by osmometer, leaf ABA content by ELISA.



RESULTS

The obtained results show enormous differences in physiological parameters between the lines of the mapping population (Fig. 1). These differences are much bigger than the differences between the parental lines, with a number of lines scoring significantly above or below the parameter values of the parental lines. The differences are more pronounced during recovery than under chilling, especially in photosynthetic efficiency (Fig. 1A). The most pronounced genotypic differences are in the extent of osmotic adjustment under chilling and during recovery (Fig. 1C).

CONCLUSIONS

- Large differentiation among lines of JxE mapping population in the measured physiological traits, particularly in photosynthetic efficiency and osmotic adjustment, forms the basis for successful genetic selection of sorghum genotypes and breeding of new cultivars with increased tolerance to chilling stress, suitable for cultivation under European climatic conditions.
- The fact that this variation exceeds the differences between the parental lines indicates transgressive segregation, with positive alleles contributed by both parents.

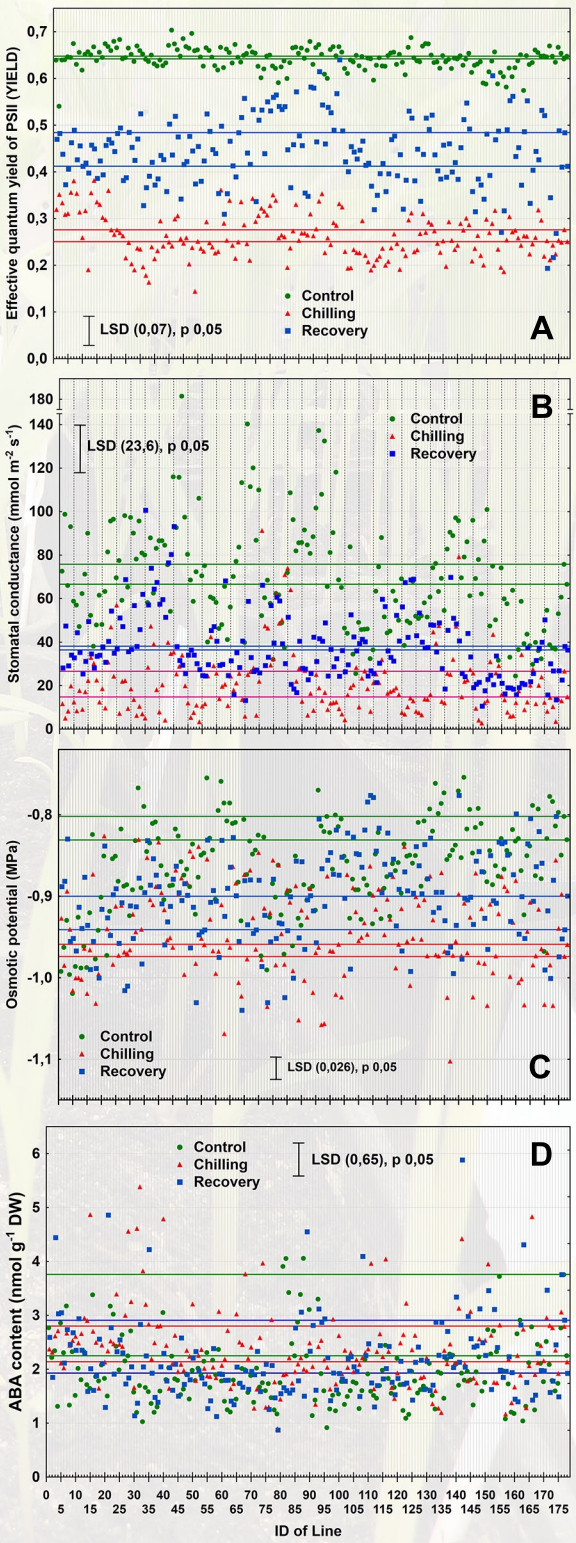


Figure 1. Photosynthetic efficiency measured as chlorophyll *a* fluorescence parameter effective quantum yield of PSII (YIELD, A), stomatal conductance (B), osmotic potential (C) and abscisic acid (ABA) level (D) for the first three seedling leaves in 176 lines of JxE mapping population of sorghum. Horizontal lines show differences of parameters between parental lines under control, chilling, and recovery conditions.

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