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Productivity of a doubled haploid winter wheat population under heat stress

Research Article

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Abstract: Breeding of new winter wheat cultivars with good heat tolerance requires better understanding of the genetic background of heat tolerance. In the present work the effect of heat stress on the 6th day after heading was investigated in a doubled haploid (DH) population arising from a cross between heat-sensitive (Plainsman V) and heat-tolerant (Mv Magma) cultivars. Averaged over the population, heat stress was found to result in a significant reduction in biomass, grain yield and grain number per plant, and in thousand-kernel weight (TKW) and harvest index. High temperature had the greatest effect on the grain yield, with a drop of 36.2% compared with the control. This could be attributed jointly to significant reductions in the TKW of the main ear and in the grain number of the side tillers. The relationship between the yield parameters was confirmed by the positive correlations obtained for the lines in the population. The diverse levels of heat tolerance in the different lines were confirmed by the significant differences in the reduction in the chlorophyll content (SPAD index) of the flag-leaves and in yield parameters. The changes in yield components in stress condition, however, can be still the most effective tools for heat stress evaluation.

Keywords: *Heat stress • Early grain filling • Grain yield • Wheat population*

1. Introduction

Winter wheat is adversely influenced by the effects of high temperature stress in many wheat-producing areas [1,2]. High temperature is often accompanied by drought stress under field conditions, so breeding and selection for high yield under heat and drought stress are important objectives for breeders working in such environments. Increasing productivity under heat stress conditions requires the development and selection of wheat cultivars tolerant of high temperatures, which in turn necessitates detailed investigations under various stress conditions. High temperature tolerance can be determined by measuring various physiological parameters [3,4] and whole-plant productivity traits including yield components such as grain yield, biomass, grain number and thousand-kernel weight (TKW). Although promising results have been obtained when using physiological screening to predict stress tolerance, the measurement of yield components under stress conditions is still the most effective way of identifying stress-tolerant wheat lines. The identification and measurement of traits conferring high temperature tolerance could contribute to understanding the genetic regulation of these traits and the genetic background of heat stress tolerance. Earliness, leaf rolling, early ground cover, shortness and stay-green are known to be associated with heat tolerance [5,6].

The damage caused by high temperature is greatly dependant on the developmental stage of the plants when subjected to the stress [7,8]. Heat stress at the beginning of flowering or during spikelet development reduces the number of potential grains. A temperature of 27°C at a slightly later developmental

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