IMPACT OF THE D GENOME AND QUANTITATIVE TRAIT LOCI ON QUANTITATIVE TRAITS IN A SPRING BREAD WHEAT BY SPRING DURUM WHEAT CROSS

by

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ABSTRACT

Desirable agronomic traits are similar for common hexaploid (6X) bread wheat (*Triticum aestivum*, 2n = 6x = 42, genome, AABBDD) and tetraploid (4X) durum wheat (*T. turgidum durum*, 2n = 4x = 28, genome, AABB). However, bread and durum wheat are genetically isolated from each other due to an unequal number of genomes that cause sterility when crossed. Previous work allowed identification of a 6X and 4X parent that when crossed resulted in a large number of recombinant progeny at both ploidy levels. In this study, interspecific recombinant inbred line populations at both 4X and 6X ploidy with 88 and 117 individuals, respectively, were developed from a cross between Choteau spring wheat (6X) and Mountrail durum wheat (4X). Lines within each population contained a mixture of alleles from each parent for loci in the A and B genomes. The presence of the D genome in the 6X population resulted in increased yield, tiller number, and seed size. The D genome also resulted in a decrease in stem solidness, lower test weight and fewer seed per spike. Similar results were found with a second RIL population containing 152 lines from 18 additional 6X by 4X crosses. Several additional QTL for agronomic and quality traits were identified in both the 4X and 6X populations. Positive durum alleles increasing kernel weight in hexaploids, on chromosomes 3B and 7A may be useful for introgression by bread wheat breeders.

CHAPTER 1

INTRODUCTION

Hexaploid (6X) bread wheat (*Triticum aestivum,* 2n = 6x = 42, genome AABBDD) is an allopolyploid, containing three unique and complete sets of chromosomes, the A, B, and D genomes. The events that led to hexaploid wheat's speciation involved two interspecific hybridization events between wild ancestors. Tetraploid *T. turgidum*, or emmer wheat, arose from a cross between *T. urartu* (A genome donor) and a species related to *Aegilops speltoides* (B genome donor). Tetraploid durum wheat (*T. turgidum* subsp. *durum*, 2n = 4x = 28) is the primary cultivated tetraploid wheat. Hybridization between tetraploid emmer wheat and the D genome donor *Ae. tauschii* (Feuillet et al. 2008, Kilian et al. 2010) gave rise to the hexaploid species *T. aestivum*. *T. aestivum* subsp. a*estivum* is the primary cultivated form of this species. Polyploidy offers advantages and disadvantages for the success of a species. The presence of multiple genomes offers potential for heterosis to be fixed within an individual. Multiple sets of genes can offer additional opportunities for improving traits of interest and importance. Multiple copies of the same gene allow for the masking of negative recessive alleles by positive dominant alleles (Comai 2005). However, polyploidization also causes genetic separation between the new polyploid and its ancestors, reducing the amount of available genetic diversity (Haudry et al. 2007). Hybrids between related species with different ploidy levels tend to produce a high frequency of sterile progeny (Lanning et al. 2008). That isolates the common bread