INTERACTION OF TRITICUM BOEOTICUM CYTOPLASM AND GENOMES OF T. AESTIVUM AND T. DURUM: RESTORATION OF MALE FERTILITY AND PLANT VIGOR

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SUMMARY


INTRODUCTION

KIHARA (1951) reported that common wheat plants with A. caudata cytoplasm were male sterile. The male sterility due to A. caudata cytoplasm was associated with partial female sterility and pistilloidy. A common wheat addition line with an A. caudata chromosome carrying male fertility restoring gene(s) was derived by Kihara. FUKASAWA (1953) reported cytoplasmic male sterility in T. durum due to A. ovata cytoplasm. Male sterile T. durum plants with A. ovata cytoplasm had delayed maturity. FUKASAWA found that 29-chromosome T. durum plants (with A. ovata cytoplasm) with one chromosome from A. ovata were partially male fertile. The cytoplasmic male sterility due to A. caudata and A. ovata was not suitable for hybrid wheat research because of the associated pistilloidy or delayed maturity of the male-sterile plants.

WILSON and ROSS (1962) obtained cytoplasmic male-sterile common wheat with

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MALE FERTILITY AND VIGOR OF (TRIT. BOEOTICUM) WHEAT

T. timopheevi cytoplasm, and no apparent undesirable side effects were associated with male sterility due to T. timopheevi cytoplasm. Common wheats with factors restoring male fertility for the T. timopheevi source of cytoplasmic male sterility were reported by Wilson (1962) and Schmidt et al. (1962). Maan and Lucken (1967, 1968a) have developed cytoplasmic male-sterile and male-fertile lines of common wheats in T. zhukovskyi and T. araraticum cytoplasms. Maan and Lucken (1969) reported that some of the T. dicoccoides types from Turkey and Iraq had male sterility inducing cytoplasm. Also, male fertility restoring factors from T. zhukovskyi and T. araraticum produce fertile hybrids from crosses with male-sterile common wheats with T. timopheevi cytoplasm (Maan and Lucken, 1968a). Possibly, the members of the timopheevi complex may have the same or similar cytoplasms.

Maan and Lucken (1967, 1968a, 1968b) reported that male-sterile T. durum plants with T. boeoticum or T. monococcum cytoplasm had highly reduced plant vigor and segregated for varying degrees of reduced vigor. Sue moto (1968) confirmed that male-sterile T. turgidum or T. durum plants with T. boeoticum or T. monococcum cytoplasm had reduced vigor and several morphological abnormalities which appeared in the first backcross progeny.

This paper reports the development of cytoplasmic male-sterile A lines and male-fertile R lines of common wheat in the cytoplasm of T. boeoticum (2n = 14) and amphidiploid T. boeoticum-A. squarrosa. The R lines in T. boeoticum cytoplasm had normal plant vigor and fertility. Also, restoration of male fertility and plant vigor was studied in A line x R line hybrids with T. boeoticum and T. timopheevi cytoplasm.

MATERIALS AND METHODS

T. monococcum (2n = 14), T. boeoticum (2n = 14), tetraploid T. boeoticum (2n = 28) from M. Tanaka, Japan, amphidiploid T. boeoticum-A. squarrosa from E. R. Sears, and amphidiploid T. boeoticum-T. durum were used as females (cytoplasmic donor) in crosses with T. durum and T. aestivum. The male parents (genome donor) were T. durum selection 56-1, T. aestivum varieties Selkirk, Chris and Chinese Spring.

The following male-sterile common wheats in T. timopheevi cytoplasm were used in test crosses: Waldron, Ciano 67, Chris, Polk, Minn. 11-54-30, Minn. 1162-68, N.D. 480 and N.D. 481.

Two of our most effective R lines T. zhukovskyi/3*T. aestivum, Justin (R5) and T. timopheevi/2*T. aestivum, Marquis F10/Sonora-64, were used in the test crosses with A lines of common wheat. In this paper the R lines in the cytoplasm of the amphidiploid T. boeoticum-A. squarrosa/T. aestivum, Chinese Spring and the R line in T. boeoticum cytoplasm, T. boeoticum/2*T. durum//2*T. aestivum, Selkirk are designated as R6 and R7, respectively.

The parental R line plants and the F1 hybrid testcrosses were grown in paired progeny head rows for visual estimates of anther score and percent seed set. The R line head rows that sired the most fertile test cross F1 hybrids with one or more male-sterile A lines were used for further test crosses and selection.

The anther scores were made by examining several anthers from a head and rating on a scale of 0–5. Anthers on plants scored 0 appear completely sterile throughout.