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Durum wheat (*Triticum turgidum*, L.) carrying the 1BL/1RS chromosomal translocation: agronomic performance and quality characteristics under Mediterranean conditions

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Abstract

Eight isogenic lines of the durum wheat cultivar Altar 84, four lines with the 1BL/1RS chromosomal translocation and four lines without it, were evaluated in relation to agronomic and quality characteristics under Mediterranean conditions. Four experiments were established during 1994–1995 and 1995–1996 under contrasting Mediterranean environments. Spikes (m^{-2}), grain number (m^{-2}), thousand-kernel weight, harvest index, grain yield, grain protein concentration, flour yellowness (b-yellowness index), and flour SDS-sedimentation volume were determined. Environment significantly affected all agronomic and quality characteristics. Grain yield values ranged from 1.4 to 5.4 mg ha^{-1} among experiments, showing the wide productivity range represented by the testing locations. Besides thousand-grain weight, which was higher in the 1BL/1RS isogenic group than in the 1B isogenic one, no differences in any other agronomic trait were observed in association with the presence of the translocation. However, quality characteristics evaluated differed statistically between lines with and without 1BL/1RS translocation. The genotype × environment interaction associated with the presence of the translocation, was significant for grain yield, harvest index, and SDS-sedimentation. The 1BL/1RS isogenic group showed higher grain yield than the 1B one only in Jerez de la Frontera, where drought-stress was severe. The 1BL/1RS translocation was associated with higher grain protein and flour yellowness, and with lower SDS-sedimentation. Although the introduction of the 1BL/1RS translocation could improve the agronomic performance under drought-stress conditions, its negative effect on gluten strength could limit the commercial exploitation of translocated durum wheat genotypes.

Keywords: Drought-stress; Grain yield; Grain protein concentration; SDS-sedimentation; Flour yellowness

1. Introduction

The 1BL/1RS chromosomal translocation has been widely introduced in bread wheat as a method to improve agronomic performance and grain yield. From 1991 to 1995, 45% of 505 commercial cultivars of

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bread wheat from 17 countries carried this wheat-rye translocation (Rabinovich, 1998).

The 1RS arm from rye (*Secale cereale*, L.) has several genes, which offer race-specific resistance to major rust diseases, better adaptation, and stress tolerance, characters that could enhance the grain yield potential in hard red winter and spring wheat. From 1979 to 1982 four bread wheat (*Triticum aestivum*, L) sibs of the cross known as Veery, tested in 153 different environments world-wide, ranked as top yielders across environments (Rajaram et al., 1983). The grain yield advantage of 1BL/1RS translocation in bread wheat with similar background, has been confirmed by several studies (Moreno-Sevilla et al., 1995a; Carver and Rayburn, 1994; Schlegel and Meinel, 1994; Villareal et al., 1995). Superior aerial biomass and higher kernel weight have been associated with the presence of this translocation (Moreno-Sevilla et al., 1995a, 1995b; Carver and Rayburn, 1994; Schlegel and Meinel, 1994; Villareal et al., 1991, 1994, 1995; Bullrich et al., 1998).

Nevertheless, there are concerns regarding the negative influence of 1RS segment on bread wheat end-use quality potential. Several studies have reported a detrimental effect on gluten strength, but, at the same time, they have remarked the wide variability among genotypes, indicating the possibility of selection for acceptable quality (Dhaliwal et al., 1987; Barnes, 1990; Graybosch et al., 1990, 1993; Peña et al., 1990; Amaya et al., 1991; Fenn et al., 1994; Carver and Rayburn, 1995; Burnett et al., 1995; Lee et al., 1995; Moreno-Sevilla et al., 1995b; McKendry et al., 1996b; Jin and Mares, 1996).

Due to the advantages of 1BL/1RS on the agronomical performance of bread wheat, this translocation has also been introduced in durum wheat (*Triticum turgidum* var. *durum*). Friebe et al. (1987) described the production of cytological stable wheat-rye translocation in the durum wheat cultivar 'Cando'. Villareal et al. (1997) evaluated the agronomic performance of interrelated durum wheat stocks possessing the 1BL/1RS translocation developed by CIMMYT under irrigation conditions of Yaqui's Valley (Mexico) (Mujeeb-Kazi et al., 1996). They found that the 1BL/1RS lines gave higher grain yield than the normal lines due to an increase in aerial biomass, kernel weight and test weight. However, differences for quality parameters were not assessed in this study.

Under Mediterranean climate, where drought-stress conditions could affect the agronomic performance and yield potential of small grain cereal crops, the presence of the 1BL/1RS translocation may contribute to enhance grain yield in durum wheat, since the 1RS arm from rye has several genes which offer better adaptation and stress-tolerance. However, there is no study examining the agronomic performance under Mediterranean conditions and quality characteristics of durum wheat possessing the 1BL/1RS. Therefore, the present study evaluates the influence of the 1BL/1RS translocation on some agronomic and quality characteristics of durum wheat under Mediterranean climatic conditions.

2. Materials and methods

2.1. Plant material

Eight isogenic lines of the durum wheat (*Triticum turgidum* var. *durum*) cultivar 'Altar 84' obtained at CIMMYT (Mujeeb-Kazi et al., 1996), four carrying the 1BL/1RS translocation and four without it, were used in the present study. To introduce the 1BL/1RS translocation, the bread wheat (*T. aestivum*, L) cultivar 'Seri 82' was used as donor of the 1RS arm. The durum wheat cultivar 'Altar 84', was used as female and recurrent progenitor. By C- and N-banding techniques, homozygous lines with 1BL/1RS and homozygous 1BL/1BS were selected (Mujeeb-Kazi et al., 1996).

2.2. Experimental design

Four experiments were established during 1994–1995 and 1995–1996 growing seasons under contrasting Mediterranean environments of Spain. Trials were carried out in three locations: Torregrossa (1994–1995, 1995–1996), La Tallada (1995–1996), and Jerez de la Frontera (1995–1996). Torregrossa (Lleida), Northeast Spain, is located in a temperate Mediterranean climate area. La Tallada (Girona), Northeast Spain, is close to the Mediterranean coast, with a high maritime influence over the climate, and it is considered as humid Mediterranean area. Jerez de la Frontera (Cadiz), South Spain, is located in the dry Mediterranean area. Detailed climatic and soil characteristics of sites and years are given in Table 1.