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A Sustainable Durum Wheat Chain for Food Security and Healthy Lives

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Assessing yield and quality traits of durum wheat varieties, landraces and recombinant lines with alien introgressions in Turkish and Italian environments under rainfed and irrigated conditions

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Introduction

Durum wheat (DW) is a staple crop for several Mediterranean countries. As domestication and breeding programs have markedly reduced the genetic variability of this crop, enhancing DW resilience to abiotic stresses has become a challenge and a crucial target for both researchers and stakeholders, especially in the recent climate change scenario. Within PRIMA program, the project IMPRESA aims to widen DW genetic basis by resorting to cultivated genotypes and also to introgression lines involving wild wheat relatives, naturally adapted to stressful environments. To this objective, field trials were performed in Italy (IT) and Turkey (TR) testing DW genotypes under rainfed (RF) and irrigated (IRR) conditions.

Materials and Methods

The same field trial was carried out in 2020-21 season at the experimental farm of the University of Tuscia, Viterbo (VT), Central Italy and in two Turkish localities: Koruklu (KOR), located in the DW belt, and Adiyaman (ADI). The 27 DW genotypes, common to all locations and conditions, included 15 Turkish cultivars and 2 landraces, 3 DW-*Thinopyrum ponticum* recombinant lines (R5+, R112+, R23+) and their control sibs, 2 R5-derived multiple recombinants (RRR55-2, RR68-6), besides Simeto (IT) and Khiar (Tunisia), involved in recombinants' pedigree. The irrigation treatment consisted of 5 applications, starting from May 19th (near heading) and ending on May 31st, 2021. For each application, the amount of water necessary to replace the total evapotranspiration net of precipitations was applied. Nitrogen fertilization (180 kg ha^{-1}) was split into three applications. Harvesting was performed on July 14th, 2021, using a plot harvester (Fig. 1). A split-plot design with three replicates was used. The data reported here for both irrigated and rainfed plots were grain yield (g m^{-2}), recorded in each locality; yellow index (coord. b), protein content (%), and SDS (mm), recorded in VT and KOR. Data were subjected to the analysis of variance (ANOVA) and significantly different means were separated at the 95% probability level by the Tukey test.

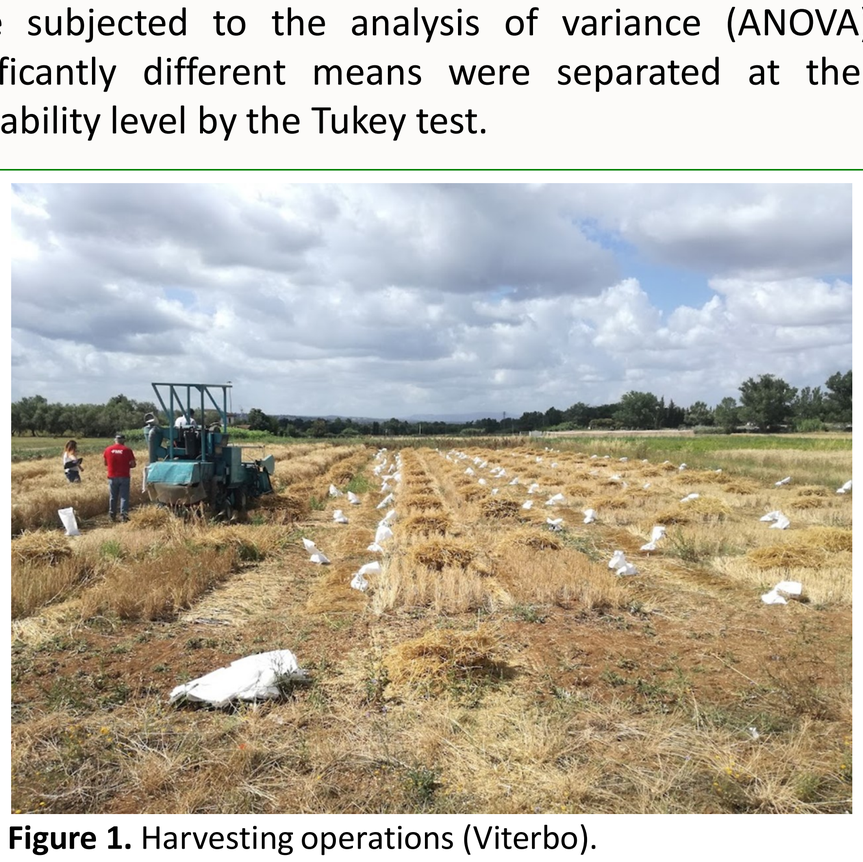

Figure 1. Harvesting operations (Viterbo).

Conclusions

- Useful directions for breeding purposes were gathered from the results of these field experiments;
- Top yielders in both stress and optimal conditions were Ayzer, Khiar and R5+;
- All recombinant lines together with Ayzer, Güney Yıldızı and Sümerli showed good quality traits.

Results

Here we report the results of trials conducted in 2020-21 under rainfed (RF) and irrigated (IRR) regimes. Averaged over localities, irrigation provided a yield increase of about 60%. Best performers in RF condition were Akçakale2000, Ayzer, Khiar, Sari başak, and R5+, while in IRR regime were Güney Yıldızı, Ayzer, R5+, and Khiar (Fig. 2). In IT, grain yield (GY) was 20% lower in RF than IRR conditions. Top producers in RF were Akçakale2000, R5+, R112+ and Sari başak, while in IRR were Alatay and the multiple recombinants, besides R5+ and R112+. In TR, GY was 2.5 (KOR) and 1.5 (ADI) times higher in IRR vs. RF. Best yielders in RF were Khiar and Ayzer (both sites), and RRR55-2 (KOR), R112+ and R5+ (ADI) among recombinant lines. Khiar and Ayzer performed very well also in IRR, besides Tüten2002, Zürhe and Artuklu, Simeto and R5+ (KOR) and Güney Yıldızı, Tüten2002 and Sari başak (ADI).

As for quality, R112+ had an excellent combination of high yellow index (from *Th. ponticum*), protein content and SDS in both KOR and VT (Fig. 3). High yellow index had all recombinant lines, besides Ayzer, Güney Yıldızı and Sümerli. Poor performances were shown by the two landraces (Devedişi and Hacı Ali) for both yield and quality traits.

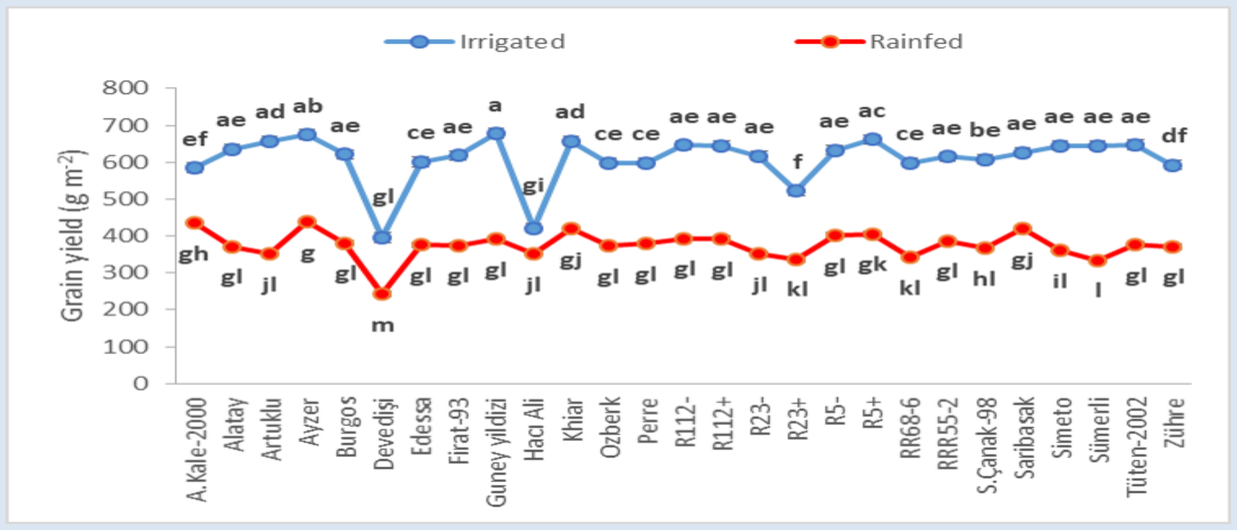

Figure 2. Grain yield (irrigation × genotype interaction). Letters correspond to the ranking of the Tukey test at $P < 0.05$.

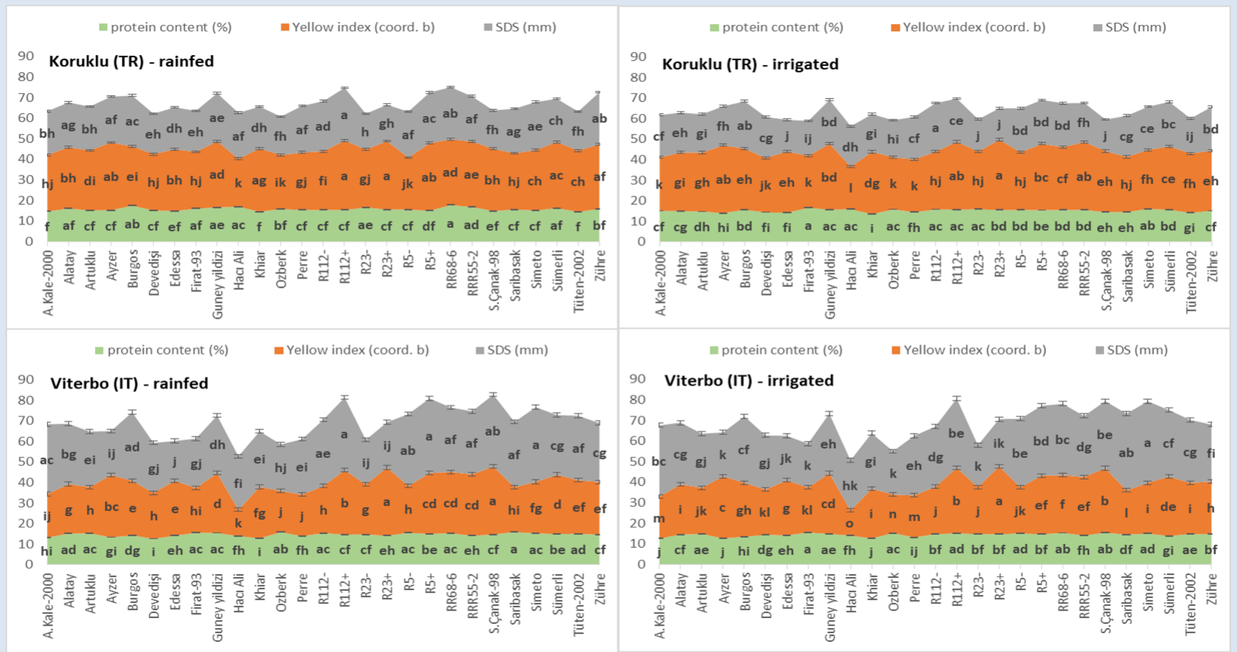

Figure 3. Quality traits of tested genotypes in each locality and condition. For each trait, letters correspond to the ranking of the Tukey test at $P < 0.05$.