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Objectives

The CerealMed research project (Enhancing diversity in Mediterranean cereal farming systems 2020-2023) is aimed implementing a biodiversity-based wheat cropping system in the Mediterranean area. This study was aimed at exploring wheat biodiversity for key grain quality related traits to improve durum and bread wheat for quality and healthiness of end products.

Methods

A population of nearly 130 introgression lines (ILs) (genome of *T. dicoccoides* Ag218 introgressed into durum wheat PR22D89) and 59 *T. aestivum* subspecies (8 ssp. *aestivum*, 23 ssp. *compactum*, 12 ssp. *macha*, 10 ssp. *spelta*, 5 ssp. *sphaerococcum*, 1 ssp. *vavilovii*) have been evaluated during 2020-2021 growing season in a field trial in two locations. The experimental design consisted of a randomized complete block with two replicates. Seeds were harvested at maturity and stored for evaluation of quality traits. About 40 g of kernels for each sample were grinded with Cyclotec using 1 mm sieve and the flours subjected to determination of carotenoid content through spectrophotometer readings after extraction with saturated buthanol (AACC 14-50) and by NIR. Protein content and SDS were also evaluated by NIR technology, while total polyphenols were determined by spectrophotometer method. Two technical replicates for each measure were done and data were corrected with respect to dry weight.

Results

The parents of the IL population showed very clear differences for traits measured by NIR, as carotenoid and protein content, and total polyphenols in both Foggia and Fiorenzuola (Table 1). Despite characterized by lower values of carotenoid content with respect to tetraploid ILs as expected, hexaploid lines showed a good variation for this trait (Table 2) which, integrated with data in tetraploid wheats, allowed to greatly improve the NIR carotenoid calibration curve (Figure 1).



Parameter	PR22D89	PR22D89	Ag-218	Ag-218
Total carotenoids (mg/kg DM)	9.25	8.26	4.15	3.73
Proteins (% DM)	16.35	14.61	23.02	20.57
SDS (% DM)	16.21	16	21.48	21.5
Total polyphenols (µg/g DM)	-	1015.5	-	1023.5
	Fiorenzuola	Foggia	Fiorenzuola	Foggia

Table 1. Mean values of total carotenoid, protein content and total polyphenols in the parents of the IL population in two locations.

Total carotenoids (mg/kg DM)	Mean	Median	Min.	Max.	Variance	Std. Dev.	Error
Tetraploid ILs	8.66	8.70	4.15	10.09	0.53	0.73	0.06
Hexaploid lines	4.31	4.42	2.47	6.33	0.78	0.88	0.11

Table 2. Total carotenoid content in the IL population and in the hexaploid collection.

Discussion & Conclusions

Carotenoid content is a grain quality trait important to improve also for the healthy value of end products. This trait has been hampered in particular in durum wheat breeding, as consumers traditionally prefer a yellow-colored pasta, while bread wheat flour is characterized by a white color. For this reason, the hexaploid wheat collection examined in the present study is particularly interesting as it shows carotenoid content values which are much higher compared to those reported for bread wheat, and lower with respect to those observed in the durum ILs. This allowed to reach a very wide range of carotenoid content values, so to greatly improve the NIR carotenoid calibration curve, which is a very valuable tool for high-throughput phenotypic assessments in genetic analysis. Indeed, the difference in carotenoid content between the ILs parents and the subsequent analysis of the whole population will lead to mapping genetic determinants controlling this trait, as well as the other traits determined, protein content, SDS, and total polyphenols, whose characterization is ongoing in the whole population.

