International Conference
FROM SEED TO PASTA III
A Sustainable Durum Wheat Chain for Food Security and Healthy Lives
Bologna - Italy, 19-21 September 2018

GENETIC IMPROVEMENT OF CHILEAN DURUM WHEAT (*TRITICUM TURGIDUM* L. VAR. *DURUM*) GERMPLASM THROUGH INTEGRATED BREEDING APPROACHES

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Studying the carotenoid biosynthetic pathway to increase the grain yellow pigment content (GYPC) and the nutritional value of grains of durum wheat (DW) is key to benefit the consumers and the industry. In this context, the effects of phytoene synthase (*PSY*), the main candidate gene influencing GYPC of nine cultivars utilized in Chile, and of lycopene epsilon cyclase (*LCYE*) on the nutritional value of grains of DW were investigated. To test the hypothesis of the association between the already identified *PSY* alleles related to high GYPC, *PSY* was studied using PCR followed by sequencing based upon the existing allelic variants of *PSY-A1* and *PSY-B1* obtained from the literature. In this way, the superior *PSY* allelic variants associated with high GYPC were identified and characterized. Regarding *LCYE*, Targeting-Induced Local Lesions IN Genomes (TILLING), a powerful reverse-genetic strategy for the discovery and mapping of induced mutations was used. This technique would likely allow the identification of nutritionally-enhanced seeds with higher content of provitamin A through HPLC. Overall, the main results of our studies show medium-low GYPC levels of the current Chilean commercial varieties of DW, reflecting the need of improving this trait through breeding. The allelic variant I (*PSY1A-**I***) associated to higher GYPC. Using molecular markers associated to *PSY1A* (i.e., Psy1-A1_STS and YP7A-2 jointly) for marker-assisted selection can be sufficient and valuable to improve grain yellowness. In addition, *PSY1A* was 21-fold higher expressed in the high-yellowness relative to the low-yellowness genotypes at day 35 days after anthesis through q-PCR during grain filling. A major role for *PSY1A* in the genotypes associated to high GYPC was concluded. Finally, the substitution W437* increased β-carotene and total carotenoids content in leaves of one *LCYE* mutant line of the Kronos TILLING population, but no differences relative to the control were found in grains through HPLC.

Acknowledgements: this work was supported by Conicyt [Chile´s National Commission for Scientific and Technological Research], grant Fondecyt de Iniciación n°11110066 (2011-2014), and Fondecyt Regular n°11611298 (2016-2020).

ABSTRACT