Molecular characterization of some Romanian wheat cultivars using functional molecular markers for grain weight

Authors: Daniel Cristina1,2*, Alina-Gabriela Turcu 1, Vasile Mandea 1, Calina-Petruta Cornea 2 and Matilda Cluca 1
1- National Agricultural Research and Development Institute Fundulea, N.Titulescu street; no.1, Calarasi; Fundulea; 915200; Romania
2- University of Agronomic Sciences and Veterinary Medicine of Bucharest 59 Mărăști Boulevard, District 1 București, 011464
*danielcristina8@gmx.com

Key message: Functional markers for several genes associated with grain weight revealed high genetic variability among 26 Romanian wheat genotypes for most analyzed loci, and suggest presence of other important genes.

Keywords: one thousand grain weight, TGW, functional molecular markers, wheat yield

INTRODUCTION

Food production and food security, influenced by climate changes, soil availability and accessibility, soil degradation, increase of the world population and other factors, lead to new challenges for farmers, breeders and scientist worldwide.

Wheat yield is a trait controlled by numerous genes with additive and epistatic effects that are highly interactive with the environment. Larger grains are directly related with higher yield but also have favorable effects on seedling vigor and early growth, thereby promoting and stabilizing yielding ability. Large grain size has been an important trait and it is usually measured in plant breeding practice by one thousand grain weight (TGW). TGW, mainly determined by grain width, grain length and grain thickness, but also by grain shape and density, is a complex trait and a more detailed knowledge of its genetic control is useful for breeding programs and breeding efficiency worldwide.

In this study we focused on the molecular characterization of 24 Romanian wheat cultivars released between 1933–2015 and 2 breeding lines, using functional markers for genes associated with TGW such as TaGW2 (Ilang et al. 2011), TaGW2-6A (Su et al. 2011), TaGSS-3A (Ma et al. 2015), TaTEF-7A (Zheng et al. 2014), TaCw-A1 (Ma et al. 2012), TaES-D1 (Zhang et al. 2014), 6-SFT-A2 (Yue et al. 2015).

MATERIALS AND METHODS

The plant material used in this study comprised of 24 Romanian wheat genotypes released between 1933–2015 and 2 breeding lines (F628 and F132). Seeds were harvested from yield trials performed at Fundulea (South Romania) in 2013, 2014 and 2015.

Genomic DNA was extracted from two grained (ground to fine power with a mortar and pestle). DNA extraction was performed using extraction buffer based on SDS, DNA purification using Chloroform:isoamyl alcohol mixture (24:1 v/v) and DNA precipitation performed with absolute Ethanol.

PCR reactions for analyzed genes were performed in 10 to 20 µl final volume reaction and 50-100ng DNA according to the requirements of each amplification.

RESULTS AND DISCUSSION

The results are synthesized in the following table, favorable haplotypes are highlighted in red.

| Genotypes | Hap L | Hap H | Hap III | Hap 7A | Hap 7B | Hap 7C | Hap 7D | Hap 7E | Hap 7F | Hap 7G | Hap 7H | Hap 7I | Hap 7J | Hap 7K | Hap 7L | Hap 7M | Hap 7N | Hap 7O | Hap 7P | Hap 7Q | Hap 7R | Hap 7S | Hap 7T | Hap 7U | Hap 7V | Hap 7W | Hap 7X | Hap 7Y | Hap 7Z |
|-----------|-------|-------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| cereal | 4.06 | 3.40 | 3.88 | 4.57 | 6.57 | 7.97 | 3.11 | 3.37 | 3.66 | 3.94 | 4.23 | 4.52 | 4.81 | 5.10 | 5.39 | 5.68 | 5.97 | 6.26 | 6.55 | 6.84 | 7.13 | 7.42 | 7.71 | 8.00 | 8.29 | 8.58 | 8.87 |
| cereal | 4.06 | 3.40 | 3.88 | 4.57 | 6.57 | 7.97 | 3.11 | 3.37 | 3.66 | 3.94 | 4.23 | 4.52 | 4.81 | 5.10 | 5.39 | 5.68 | 5.97 | 6.26 | 6.55 | 6.84 | 7.13 | 7.42 | 7.71 | 8.00 | 8.29 | 8.58 | 8.87 |
| cereal | 4.06 | 3.40 | 3.88 | 4.57 | 6.57 | 7.97 | 3.11 | 3.37 | 3.66 | 3.94 | 4.23 | 4.52 | 4.81 | 5.10 | 5.39 | 5.68 | 5.97 | 6.26 | 6.55 | 6.84 | 7.13 | 7.42 | 7.71 | 8.00 | 8.29 | 8.58 | 8.87 |
| cereal | 4.06 | 3.40 | 3.88 | 4.57 | 6.57 | 7.97 | 3.11 | 3.37 | 3.66 | 3.94 | 4.23 | 4.52 | 4.81 | 5.10 | 5.39 | 5.68 | 5.97 | 6.26 | 6.55 | 6.84 | 7.13 | 7.42 | 7.71 | 8.00 | 8.29 | 8.58 | 8.87 |

Our results showed that some of the favorable haplotypes were present in Romanian cultivars since 1933 (A15). Analyzed genotypes showed genetic variability among all the loci except the TaCw-A1, where all genotypes carried the favorable haplotype. Results suggest the presence of other important genetic factors with positive/negative influence on TGW. Also, we found, for 6-SFT-A2 gene, a NEW polymorphism in a breeding line F06028G34-1 (F628). Future research is needed to establish if this new polymorphism is associated with desirable agronomic traits.

ACKNOWLEDGEMENTS

The present work was funded through the MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT – ROMANIA, Research Project ADER116 (2015-2018).

REFERENCES