Wild Triticeae relatives as a genetic resource for anthocyanin content in wheat grains

Alexandru Dumitru

National Agricultural Research and Development Institute Fundulea, 1 Nicolae Titulescu street, 915200, Calarasi, Romania,
phone +40213154040
E-mail: alexandru.dumitru0402@yahoo.com

INTRODUCTION

Wild Triticeae relatives can be successfully exploited in breeding programs for resistance to biotic and abiotic stress factors, but also for genes involved in the synthesis of biochemical compounds with phytotherapeutic properties such as anthocyanins. These secondary plant metabolites are a class of flavonoids and are natural pigments responsible for the blue, red or purple color in flowers, fruits and vegetative organs. As dietary compounds, anthocyanins may play an important role due to their antioxidant activities by acting as free radical scavangers, thus preventing the occurrence of diseases associated with oxidative stress. Anthocyanins also show beneficial health effects by having anti-proliferative, anti-inflammatory and antimicrobial properties.

While red and white are the common colors of the wheat grains, colored wheat can be obtained through intergeneric and interspecific hybridization processes. Depending on the type and distribution of anthocyanins in the structure of the caryopsis, there are three categories of colored wheat: purple, blue and black.

Purple wheat contains anthocyanins in the pericarp. The purple pericarp character is controlled by three dominant alleles: *Pp-B1* (on chromosome 7B of *Tr. durum*, 7S of *Ae. speltoides*), *Pp-D1* (7D, *Tr. aestivum*) and *Pp3* (2A, *Tr. aestivum*). The purple pericarp character is expressed only in the allopolyploid forms.

Blue wheat contains anthocyanins in the aleurone layer. This trait has been observed in species belonging to Aegilops, Triticum, Thinopyrum and Secale genera. The blue aleurone trait is controlled by genes from different wild relatives: *Ba1* (a dominant gene from *Thinopyrum ponticum*), *Ba2* (a semi-dominant gene from *Tr. monococcum*/*Tr. boeoticum*) and *BaThb* (a dominant gene from *Th. bessarabicum*).

Black wheat contains anthocyanins both in the pericarp and aleurone layer. Purple wheat has a high concentration of cyanidin derivates while in blue wheat delphinidin derivates are the main anthocyanins. In colored wheat, accumulation of anthocyanins starts in the middle of grain filling and the genotype-environment interactions determine the total anthocyanin content. This character can be influenced by biotic and abiotic factors as temperature, fungal diseases, soil fertilization and the grain position in spike.

MATERIALS AND METHODS

At NARDI Fundulea, diverse genetic resources were used in interspecific crosses in order to obtain colored wheat: wild relatives (*Triticum monoccocum ssp boeoticum*, *Triticum urartu*) and durum wheat varieties (Agedur and Condur).

RESULTS

In different years, two synthetic amphiploids characterized by blue and purple grains were developed (Tabel 1). Following the hybridization, caryopses with different sizes and degrees of pigmentation were identified compared to caryopses of the durum wheat varieties (Fig.1). Thus, individual selection and multiplication stages of the seed of interest are carried out.

Tabel 1. Colored wheat lines developed at NARDI Fundulea

LINE	GENEALOGY	CHARACTERISTICS
E-31 A	**Condur x *Triticum monoccocum ssp boeoticum* (191)**	**• blue grains; • hexaploid genome (*AABB*A^mA^m); • winter form; • cuticular wax;**
H 391	**Agedur x *Triticum urartu* (1)**	**• purple grains; • hexaploid genome (AABBA^uA^u); • winter form; • cuticular wax;**

Fig.1 Seed samples (left to right): Condur variety, *Triticum monoccocum ssp boeoticum* (191), E-31 A, Agedur variety, *Triticum urartu* (1), H 391

CONCLUSIONS

• The biochemical composition of wheat can be improved by exploiting genetic variability and by introgression of genes involved in the anthocyanin synthesis.

• In a world that is constantly developing and where the nutritional profile of food is gaining more and more interest, obtaining productive varieties of colored, biofortified wheat with nutritional value and functional health benefits is a new desideratum in breeding.

OUTLOOKS

• Development of black wheat by crossing the synthetic amphiploids E-31 A and H 391.

• Determination of anthocyanin content in the lines of interest.

REFERENCES

Garg M., Kaur S., Sharma A., Kumari A., Tiwari V., Sharma S., Kapoor P., Sheoran B., Goyal A., Krishania M., 2022. Rising demand for healthy foods-anthocyanin biofortified colored wheat is a new research trend. Front Nutr 9:878221.