The Response of Wheat Plants with Different Allele Status of the *Gpc-B1* Gene under Zinc Deficiency

Natalia Kaznina[1*], Nadezhda Dubovets[2], Yulia Batova[1], Anna Ignatenko[1], Olga Orlovskaya[2], Natalia Repkina[1]

[*]kaznina@krc.karelia.ru

[1]Institute of Biology of the Karelian Research Centre of the Russian Academy of Sciences

[2] Institute of Genetics and Cytology of the National Academy of Sciences of Belarus

Introduction

Previously, it was found that the *Gpc-B1* gene, encoding NAC (NAM, ATAF, CUC) is involved in regulation of Zn content in plants. The presence of a functional allele of the *Gpc-B1* gene tipically for wild type of wheat (*Triticum turgidum* ssp. *diccocoides*), while most of the created varieties of wheat (*Triticum aestivum*) have a deletion at this locus or a non-functional copy of this gene. The use of distant hybridization method made it possible to breed wheat lines containing a functional allele of this gene. This plants characterized by a higher content of Zn in the grain. At the same time there are fragmentary available data about reaction of wheat with functional allele of the *Gpc-B1* gene to Zn deficiency.

The major objectives of this study were to investigate the influence of Zn deficiency on growth parameters and grain production of wheat with different *Gpc-B1* allele status.

Plants material

- **Wild emmer wheat (*Triticum turgidum* ssp. *diccocoides*) carry a functional allele of the *Gpc-B1* gene;**

- **Common wheat (*Triticum aestivum*) var. Festivalnaya carry a non-functional alleles of the *Gpc-B1* gene;**

- **Introgressive lines 15-7-1 carry a functional allele of the *Gpc-B1* gene;**

- **Introgressive lines 15-7-2 carry a non-functional alleles of the *Gpc-B1* gene**

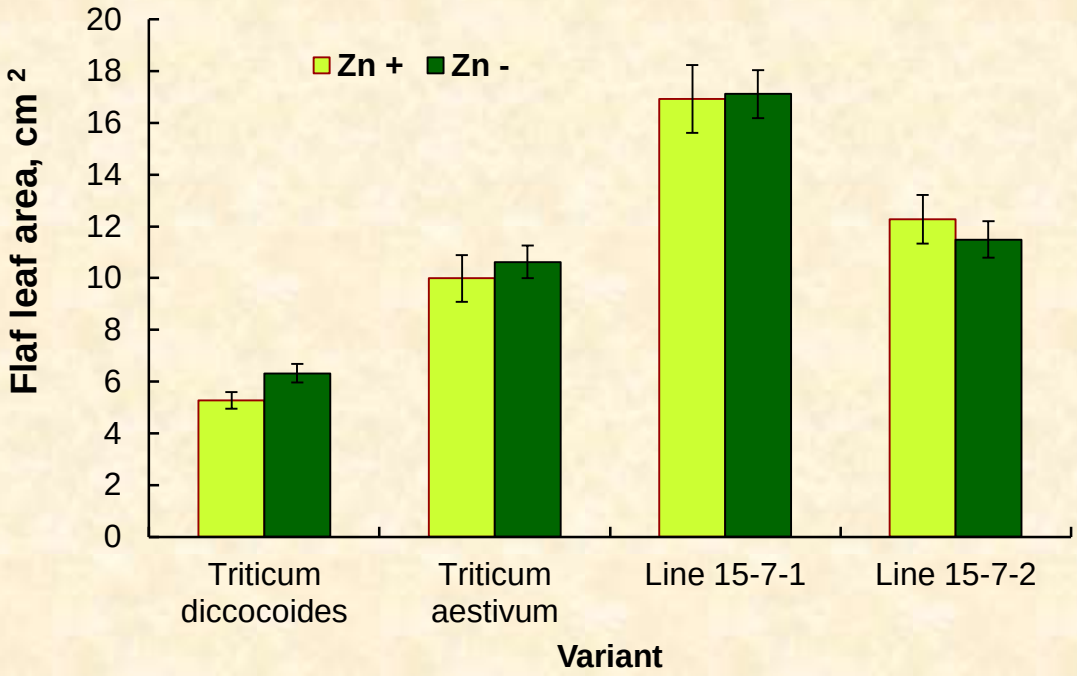
Introgressive lines were created by crossing of *T. dicoccoides* and *T. aestivum* var. Festivalnaya. Allelic status of the *Gpc-B1* gene was determinated using codominant marker *Xuhw89* (Vishwakarma et al., 2014).

The effect of Zn deficiency on shoot height and FW of wheat with different allelic status of the *Gpc-B1* gene

Variant	Shoot Height (cm)		Shoot FW (g)	
	Zn +	Zn –	Zn +	Zn -
Triticum dicoccoides	101.5±1. 98b	95.55±1.77c	2.38± 0.17d	2.60± 0.17d
Triticum aestivum var. Festivalnaya	87.42±2.58de	81.85±2.31e	5.36± 0.27abc	5.06± 0.18bc
Line 15-7-1	99.85±3.78bc	94.05±3.59bcd	6.07± 0.46a	5.87± 0.41ab
Line 15-7-2	114.26±3.33a	114.45±2.54a	4.97±0.27bc	4.84±0.26c

Averages followed by different letter within the same parameter indicate statistically significant differences according to the Fisher's least significant difference test ($P < 0.05$). The data expressed as means±SE.

The effect of Zn deficiency on the flag leaf area of wheat with different allelic status of the *Gpc-B1* gene



The effect of Zn deficiency on the spike length and DW of wheat with different allelic status of the *Gpc-B1* gene

Variant	Spike Length (cm)		Spike DW (g)	
	Zn +	Zn –	Zn +	Zn -
Triticum dicoccoides	4.38±0.14c	4.59±0.13c	0.45±0.02c	0.53±0.02b
Triticum aestivum var. Festivalnaya	7.08±0.22b	6.67±0.11b	1.01±0.10a	1.20±0.10a
Line 15-7-1	8.20±0.32a	8.41±0.29a	1.01±0.10a	1.18±0.11a
Line 15-7-2	8.21±0.19a	7.99±0.18a	1.33±0.08a	1.42±0.08a

The effect of Zn deficiency on grain number and grain yield per a spike in plants with different allelic status of the *Gpc-B1* gene

Variant	Grain Number, pieces per spike		Grain Yield, g per spike	
	Zn +	Zn –	Zn +	Zn -
Triticum dicoccoides	12.84±0.87d	14.30±0.65c	0.29±0.02e	0.37±0.02d
Triticum aestivum var. Festivalnaya	20.63±2.47b	20.75±1.92b	0.68±0.09c	0.91±0.09abc
Line 15-7-1	21.20±2.23b	21.10±2.08b	0.76±0.09bc	1.01±0.09ab
Line 15-7-2	27.79±1.23a	26.20±1.28a	0.96±0.06ab	1.07±0.06a

Photo from the site https://globalcatalog.com

The effect of Zn deficiency on Zn concentration in grains of wheat with different allele status of the *Gpc-B1* gene

Variant	Zinc Concentration (mg kg dw^{-1})	
	Zn +	Zn –
Triticum dicoccoides	25.03±0.75d	29.02±0.87b
Triticum aestivum var. Festivalnaya	34.20±1.02a	20.16±0.60f
Line 15-7-1	27.36±0.81c	31.41±0.93b
Line 15-7-2	22.37±0.36e	21.20±0.33ef

Conclusions

According our data, the wheat response to Zn deficiency does not depend on occurrence of functional allele of the *Gpc-B1* gene. Although, Zn concentration in grains was higher in wheat with functional allele the *Gpc-B1* gene in compare with wheat carrying non-functional allele the *Gpc-B1* gene.

We can supposed, that realization of the distant hybridization method for creation of wheat lines with functional allele of the *Gpc-B1*gene can be a solution for eliminate Zn deficiency in nutrition due to their capability to accumulate higher amount of Zn in grains without decrease in a yield even under Zn deficiency in substrate.

However, further research is needed to assess the potential of wheat with functional allele of the *Gpc-B1*gene growing under Zn deficiency.

Thank you for attention!