# PRIMING WITH *GAMMA*-AMINOBUTYRIC ACID ALLEVIATES OXIDATIVE STRESS DURING GERMINATION OF AGED WHEAT AND TRITICALE SEEDS

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## Introduction

Seed storage, especially under conditions of temperature and humidity fluctuation, leads to accelerated aging and loss of germination. To increase the speed and uniformity of seed germination, priming, a method based on controlled moistening and drying of grains, is increasingly being used (Waqas et al., 2019). Evidence was obtained that such a procedure can activate the antioxidant system, which mitigates the effect of oxidative stress accompanying the germination of old seeds. It is assumed that the effect of seed priming lasts for some time due to the presence of transcripts of protective proteins and the functioning of epigenetic mechanisms. It is known that the efficiency of hydropriming can be enhanced by the use of phytohormones and stress metabolites. Since senescent seeds are characterized by an imbalance between ROS generation and their neutralization, it is believed that the use of antioxidants as priming agents can mitigate the manifestation of oxidative stress and enhance the germination of old seeds (Deng et al., 2017).

## Gaba and its role in plants

In recent years, there has been increasing interest in the functions of gamma-aminobutyric acid (GABA) in plants. It is considered to be one of the most important stress metabolites, the direct protective effect of which has been linked to its participation in the maintenance of the reducing agent pool through the activation of the GABA shunt. Recently, experimental evidence has been obtained for the involvement of GABA in signaling processes involving ROS and calcium ions, leading to the activation of the enzymatic antioxidant system and the synthesis of secondary metabolites. The influence of GABA has been demonstrated to enhance seed germination in a range of cultivated plants subjected to conditions of drought, salinity, and high temperature. However, the effect of GABA priming on the germination of seeds with low seed quality has not been investigated so far.

## Objectives

The aim of the work was to study the effect of GABA treatment on the germination of wheat and triticale seeds with low germination and the state of the antioxidant system of seedlings.

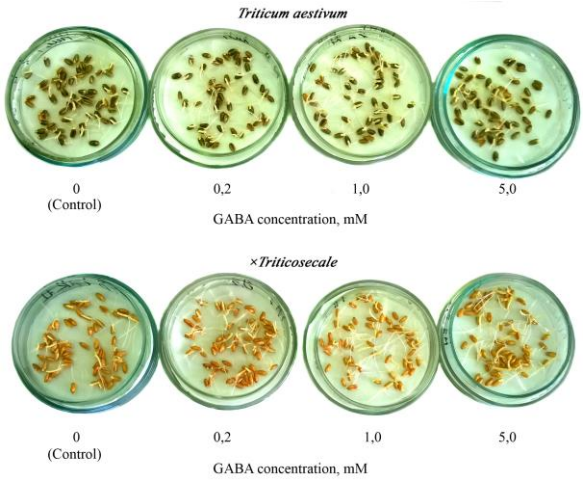


**Fig. 1.** Germination of wheat and triticale grains after 48h on wet paper

## Results

Seeds of wheat cultivar ‘Scorpion’ and triticale cultivar ‘Raritet’ of the 2020 generation were used for the experiments. The seeds were stored indoors under uncontrolled conditions for four years, which resulted in a decrease in seed germination to approximately 35-45% (Fig. 1, Fig. 2). Treatment of seeds with GABA at optimal concentration (1 mM) for 3 h followed by drying for 24 h increased germination of wheat seeds by 18% and triticale seeds by 21% compared to the hydropriming procedure. Simultaneously, root and shoot weight of seedlings of both cereal species increased significantly. In wheat and triticale seedlings treated with GABA, lower levels of O2·- generation, hydrogen peroxide content, and LPO product malonic dialdehyde were observed (Fig. 3).

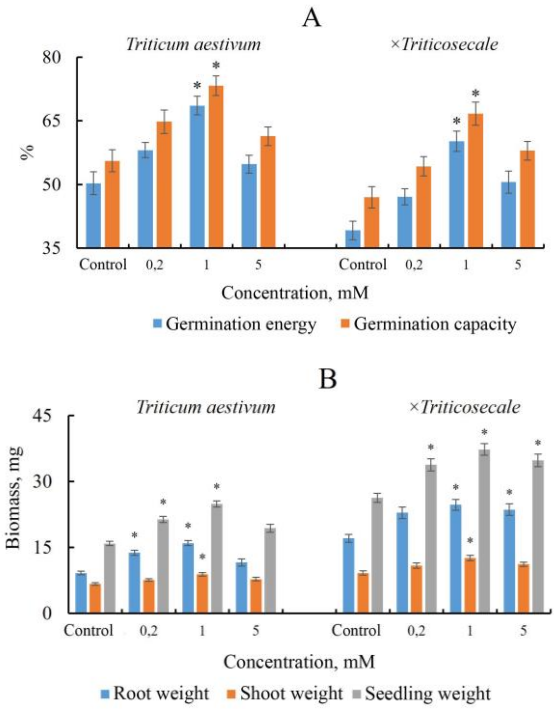


**Fig. 2.** Concentration dependence of the effect of GABA priming on germination energy, seed germination rates (A), and organ biomass of wheat and triticale seedlings (B)

An increase in the content of phenolic compounds was also observed in wheat seedlings treated with GABA, and in anthocyanins in triticale seedlings. In both cereals under the influence of GABA, an increase in catalase activity and a decrease in superoxide dismutase activity were recorded. The latter may be associated with a decrease in ROS generation and accumulation of low-molecular-weight antioxidants (Fig. 3).

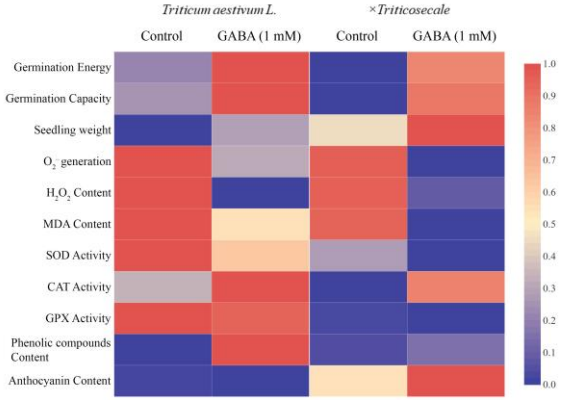


**Fig. 3.** Heat map of changes in growth parameters and antioxidant system of wheat and triticale seedlings under the influence of 1 mM GABA. All values are normalized from 0 to 1.

## Conclusion

Thus, priming of old seeds of two cereal species with GABA significantly increased their germination and improved seedling growth compared to conventional hydropriming. One of the components of the beneficial effect of GABA may be the mitigation of the effects of oxidative stress during the germination of aged seeds.