

Peroxidase activity in germinating barley grains depending on grain treatment with phytohormones

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Abstract. The article presents the data of laboratory results on the study of the effect of phytohormones on changes in the activity of peroxidase enzyme isoforms in dry seeds of malting barley and during their germination. It was found that the use of phytohormones in dry grains increases the activity of peroxidase isoforms.

1 Introduction

An important step in malting is the process of seed transition from dormancy to germination. As you know, to initiate their germination, a full amount of moisture and a favorable temperature are necessary. However, the molecular processes of seed germination are not well understood.

The use of growth regulators does not change the general direction of the process, but it can increase the rate of H₂O influx, which contributes to the earlier achievement of the threshold levels of enzyme activity necessary to activate the biochemical processes of seed germination [1]

Peroxidases (1.11.1.7) are heme-containing glycoproteins that reduce hydrogen peroxide to water, using it as an electron donor for various substrates. Cytochrome C, NADPH, trioses, ascorbate, flavonoids, etc. can serve as substrates for peroxidases. Since the activity of peroxidases is closely related to the metabolism of certain hormonal and non-hormonal compounds, an increase in the activity of these enzymes affects the reactions of transformation of its substrates [2-4].

A rapid increase in peroxidase activity in the first hours of germination of grains may indicate the participation of these enzymes in the activation of catalysts for germination of grains, initiation of lipid peroxidation (LPO) reactions, which increase the respiratory activity of mitochondria. In these reactions, glutathione peroxidase, which can transmit regulatory signals in various physiological and biochemical processes, exhibits high activity [5, 6].

Up to 14 peroxidase isoforms were found in barley grains, and according to some data, their number reaches 30. Such a large set of peroxidase isoforms indicates their active

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participation in various biochemical processes occurring in plant cells. There is a division of peroxidases into three groups: the first group is intracellular oxidases, the second and third are extracellular peroxidases [7].

Thus, during research, it was found that peroxidases, which are part of the antioxidant system of plants and contained in the tissues of seedlings, carry out protective reactions against peroxide oxidation of biomaterials and membrane structures, thereby ensuring the stability of biochemical processes occurring in them [7-10]. Phyto regulators have an antioxidant effect on plants, stimulating their resistance to stress by regulating the activity of plant enzymes [11,12].

2 Problem statement

The purpose of the research was to study the effect of phyto regulators (epin-extra, zircon, siliplant, oro- gnominal bioregulator, novosil, biodux) on the activity of peroxidase isoforms in dormant and germinating grains of malting barley.

3 Methods and materials

During the laboratory experiment, the grain of spring malting barley of the Nadezhny variety was used. The activity of peroxidase isoforms in dormant and germinated grains was determined according to Bach and Oparin. Barley grains were soaked for 1 hour in aqueous solutions of the studied phyto regulators and then germinated for 3, 5 and 7 days at a temperature of 12–14 °C. [13]. The activity of the isoforms of these enzymes at pH=5.5, 7.0, 8.0 was assessed using a phosphate buffer system (1/15 M phosphate buffer).[14] Statistical processing of the obtained results was carried out by the dispersion method and using the significant difference indicator [15].

4 Results

Considering the important role of peroxidases in the activation of the process of grain germination and antioxidant protection of cell membranes, the possibility of enhancing the activity of these enzymes under the action of phyto regulators - epin-extra, zircon, siliplant, biodux, novosil and omy was studied.

It was found that zircon had the greatest effect on the activity of isoforms of the peroxidase enzyme. It was found that on the 7th day of germination in grains, the activity of acidic (pH=5.5) isoforms of these enzymes increased by 70% compared to the control (option without phyto regulators), neutral (pH=7.0) isoenzymes of peroxidases - by 81%, alkaline (pH=8.0) – by 44% (Table 1).

Table 1. The effect of bioregulators on the activity of peroxidase isoforms in barley grain (mkat per 1 g of dry weight)

| Peroxidase isoforms | Control | Phyto regulators | | | | | | HCP ₀₅ |
|-----------------------|---------|------------------|--------|-----------|--------|---------|------------------------------|-------------------|
| | | Epin-extra | Zircon | Siliplant | Biodux | Novosil | Organo-mineral biostimulator | |
| 3 days of germination | | | | | | | | |
| acidic isoforms | 1.9 | 2.3 | 2.6 | 2.1 | 2.2 | 2.6 | 2.7 | 0.1 |
| neutral isoforms | 2.6 | 4.0 | 5.2 | 2.6 | 3.3 | 3.4 | 4.0 | 0.2 |

| | | | | | | | | |
|-----------------------|------|------|------|------|------|------|------|-----|
| alkaline isoforms | 4.3 | 5.3 | 6.6 | 4.4 | 4.6 | 5.0 | 5.5 | 0.3 |
| 5 days of germination | | | | | | | | |
| acidic isoforms | 3.0 | 4.3 | 4.5 | 3.0 | 3.0 | 4.5 | 4.7 | 0.2 |
| neutral isoforms | 4.9 | 6.1 | 6.3 | 5.9 | 6.0 | 6.1 | 6.4 | 0.3 |
| alkaline isoforms | 6.1 | 8.3 | 10.6 | 7.6 | 9.1 | 8.5 | 8.9 | 0.4 |
| 7 days of germination | | | | | | | | |
| acidic isoforms | 4.7 | 6.4 | 8.0 | 4.8 | 5.6 | 7.2 | 6.4 | 0.3 |
| neutral isoforms | 8.0 | 12.8 | 14.5 | 8.0 | 10.4 | 13.4 | 12.2 | 0.3 |
| alkaline isoforms | 11.2 | 14.4 | 16.1 | 11.3 | 12.0 | 13.4 | 13.8 | 0.7 |

A noticeable effect on the activity of peroxidase isoforms in the grain of 7-day-old seedlings was also exerted by Novosil, which increased the activity of acid isoforms of peroxidases by 53%, neutral ones by 67%, and alkaline ones by 20%. Epin-extra and organomineral bioregulator acted somewhat weaker. Under the influence of epin-extra, the activity of acid isoenzymes of peroxidases in germinating grain increased by 36%, neutral - by 60%, alkaline - by 29%. The organomineral bioregulator increased the activity of acid isoenzymes of peroxidases in seedlings by 36%, neutral ones by 53%, and alkaline ones by 23%. Biodux had little effect on the activity of these enzymes. Siliplant did not significantly affect the activity of peroxidases in the grain of 7-day-old barley seedlings.

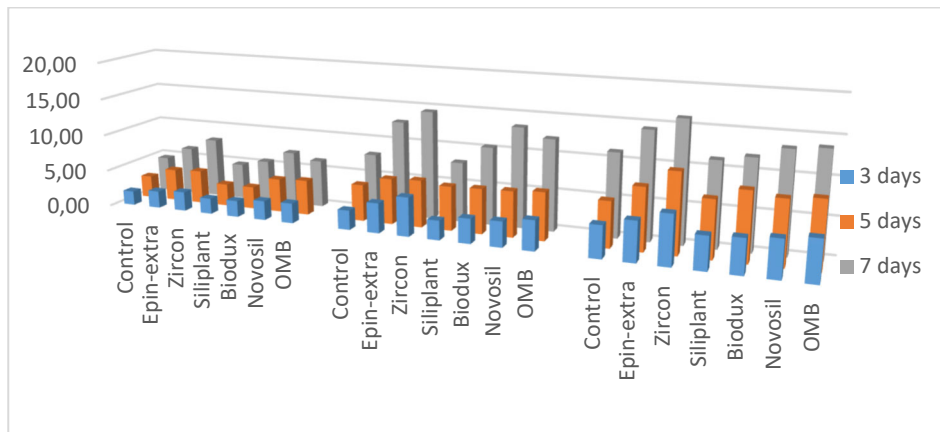


Fig. 1. Influence of phytoregulators on the activity of peroxidase isoforms

5 Conclusion

Thus, in experiments with seedlings of malting barley, a noticeable effect on the activity of peroxidases in the grain of seedlings of the phytoregulator zircon was found, which increased the activity of acid, neutral, and alkaline peroxidases by 43–81%. A rather high effect of the phytoregulator Novosil on these enzymes was also noted, which contributed to an increase in activity by 20–67%. Epin-extra contributed to an increase in the activity of peroxidase isoforms by 29–60%. The action of the organomineral bioregulator revealed an increase in the activity of peroxidase isoforms by 23–53%. The data obtained indicate that these

phytohormones activate various isoforms of peroxidases, as a result of which the process of germination of seeds of malting barley is stimulated.

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