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PROTEOLISIS OF DIFFERENT VARIETIES OF BARLEY DEPENDING ON SEED TREATMENT BY MONOCHROMATIC OPTICAL RADIATION OF RED RANGE

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Abstract

The article presents the results of studying the protein content and proteolysis in germinating seeds of different barley varieties depending on its treatment with monochromatic optical radiation of the red range (660 nm, 730 nm), which activates the phytochrome system. The obtained results suggest that the hydrolytic decomposition of reserve protein is influenced by the phytochrome system, which activates protein metabolism in germinating seeds. However, there is a difference in protein content and protease activity under the influence of seed treatment of the study varieties, what is evidence of the variety specificity of the studied processes.

Key words:

barley, monochromatic optical radiation, phytochrome, photomorphogenesis, RL (red light), FRL (far red light), proteolysis, protein content, hydrolytic decomposition of substances.

Introduction

It is known that the use of different types of pre-sowing seed treatment can significantly accelerate the activation of metabolic systems and regulatory systems. At some stages of plant cell ontogenesis, the action of exogenous factors leads to changes in self-regulatory factors. This leads to structural and metabolic reorganization, changes in the physiological state of cells and, as a result, – stimulation of plant growth and development (Kalinin 1986). One of such exogenous factors is optical radiation – light. Light – is the material and energy base for the implementation of genetic programs of autotrophic plants, acts as an external signal due to which the interaction of the genome with the environment is realized (Yakushenkova *et. al* 2001).

Formulation of problem

Monochromatic optical radiation due to photoregulatory low-energy reactions, stimulating other pigments than chlorophyll, control the individual development of the plant. One of them is phytochrome, which absorbs light in the red region of the optical spectral range. Phytochrome can exist in two forms, which are responsible for the absorption of biologically active light at 660 and 730 nm, and their interconversion initiates a further chain of events (Volotovsky 1992; Voskresenskaya 1987; Kulaeva 2001).

One of the important and difficult stages in the ontogenesis of plants is the germination of seeds. This period is characterized by the mobilization of reserve nutrients and especially by intensive metabolism, in the result of which the activity of redox and hydrolytic enzymes significantly increases and the content of reserve nutrients reduces (Ovcharov 1964).

Two varieties of spring barley (Hordeum vulgare L.) were used as research objects: Anabel and Pasadena. The originator of the Anabel variety is Saaden Union (Germany), the originator of the Pasadena variety is LP (Germany).

Before processing, barley seeds were soaked in distilled water for 2 hours and placed in a germinator on a filter paper. 50 g of seeds were placed in each germinator. The germinators were placed in a thermostat with t 250C for 6 days. For analysis, we took plants of 4 days and 7 days. Seedlings were irradiated on the 4th day for 10 minutes by red light (RL) (λ = 660 nm), far red light (FRL) (λ = 730 nm). No irradiated seedlings were used for control.

Protein content and proteolytic activity were determined in the embryo. Proteolytic activity was determined by the rate of autolysis (by increasing amine nitrogen). Protein was determined by the Lowry method. (Ermakova 1987). The results are processed statistically (Atramentova *et. al* 2008).

Purpose of research

The purpose of the study is to study the dependence of proteolysis in germinating seeds of different varieties of barley on seed treatment with monochromatic optical radiation of the red range.

Research results and discussion

The results showed that in the variety Anabel (Fig. 1), the activity of proteases in non-irradiated seeds, as well as when irradiated with RL on the fourth day was the same, and when irradiated with FRL – lower than in other versions of the experiment. On the seventh day of germination, the activity of proteases increased in the control and under the action of the RL, but did not change under the influence of the FRL. The activity of enzymes on the seventh day of germination was very high in seeds irradiated with RL, and the lowest in seeds irradiated with FRL.

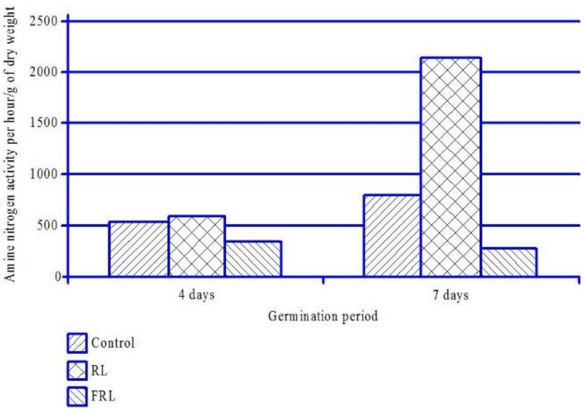

Figure. 1. The activity of proteases in the seeds germ of the variety Anabel depending on the treatment of seeds with monochromatic optical radiation of different spectral range.

The protein content (Fig. 2) on the fourth day of germination was the same in all variants of the experiment. On the seventh day in the non-irradiated and irradiated seeds, the protein content decreases compared to the data on the fourth day of germination. This is probably due to the degradation of the reserve protein for the formation of the seedling during germination. On the seventh day, the protein content in the seed germ was slightly lower when irradiate by the RL than the content in the non-irradiated seed and when irradiated with the FRL. In the last two variants, the protein content was the same. Thus, the RL most stimulates the protein degradation during seedling growth.

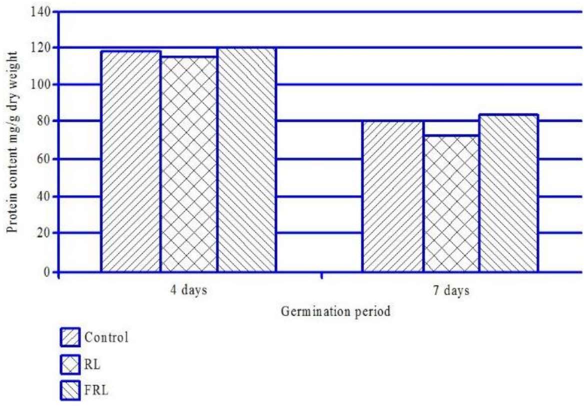

Figure. 2. Protein content in the germ of Anabel seeds depending on the treatment of seeds with monochromatic optical radiation of different spectral range.

Thus, the obtained data give grounds to establish that monochromatic optical radiation of the red range causes increased hydrolytic decomposition of protein in the seeds of the variety Anabel. This is most evident when RL irradiating. The study of the proteolytic enzymes activity in the seeds of Pasadena variety (Fig. 3) showed that on the fourth day of germination it was significantly higher when irradiated with the RL, and significantly lower when irradiated with FRL than in the non-irradiated seed. On the seventh day of germination, the activity of enzymes in irradiated seeds was much lower than in non-irradiated. Irradiation of FRL inhibited the proteases activity, compared with the activity in other variants of the experiment.

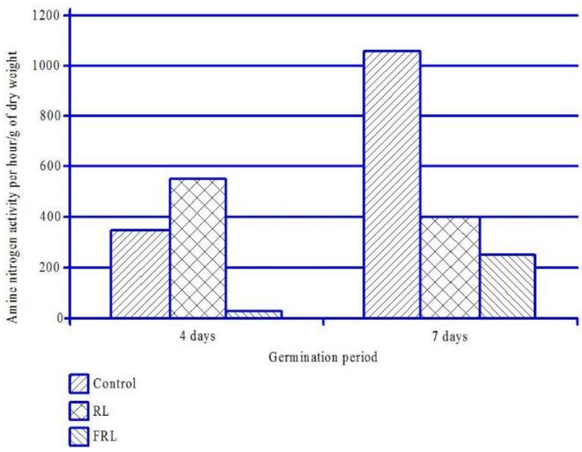

Figure. 3. Activity of proteases in the germ of Pasadena seeds depending on the treatment of seeds with monochromatic optical radiation of different spectral range.

Determination of the protein content in the seeds of the Pasadena variety (Fig. 4) showed that in the non-irradiated seed and when irradiated with the RL and the FRL, it was the same. On the seventh day of germination, the protein content in the seeds of the experimental variants decreased compared to the content on the fourth day of germination. The lowest protein content was in non-irradiated seeds. In the variants with irradiation, it was almost the same.

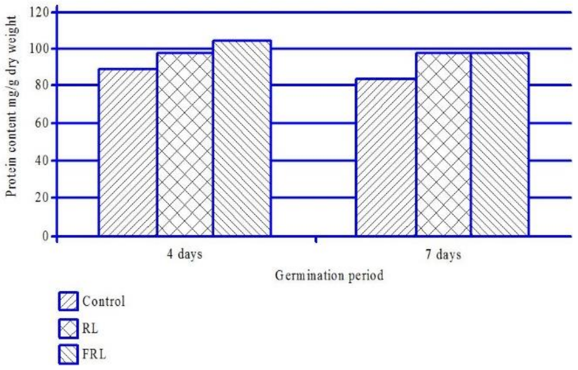

Figure. 4. Protein content in the germ of Pasadena seeds depending on the treatment of seeds with monochromatic optical radiation of different spectral range.

Thus, it is possible to assume that the activity of proteases in Pasadena seeds, as well as in Anabel variety (Figs. 1, 2), depends on the treatment of seeds with monochromatic optical radiation of the red range, which activates the phytochrome system. The hydrolytic decomposition of protein is most affected by radiation from the FRL (Fig. 3). The protein content in the seeds of Pasadena variety when irradiated does not change significantly (Fig. 4).

Conclusions

The dependence of proteolysis in barley seeds on treatment with monochromatic optical radiation of the red range found in our experiments is explained as follows. It is known that the stimulating effect of seed irradiation occurs as a result of action on the membrane. Due to this, a number of enzymes is activated, oxidative enzymatic processes is intensified, mobilization of nutrients begins faster, hydrolysis of complex endosperm reserves to easier is intensified, which easier to assimilate by germ and seedlings.

However, there is variety specificity for protein content and activity of proteases. A variety within a species is a genotype with a specific type of metabolism. It is due to genotypic specificity, the individuality of a variety and a species is possible, which occurs at the morphological and metabolic levels. The genotype at the level of a variety or species is characterized by a specific metabolism, which determines the qualitative and quantitative composition of the products of life at the biochemical level. It is probable the reason for the difference in the results of the studied varieties.

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