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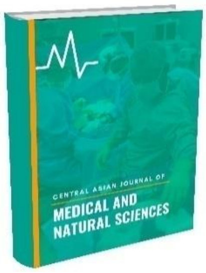

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Enzymes in Soybean Leaf and Seed

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Abstract: Environmental factors affect plant growth and productivity. As a result of abiotic and biotic effects, various changes occur in the plant cell, disrupting the balance of oxidation reactions in plants, increasing the formation of reactive oxygen species in plant cells. The enzyme activity of the antioxidant system enzymes SOD, peroxidase and catalase in plants also changes in response to the harmful effects of reactive oxygen species.

Keywords: superoxide dismutase, peroxidase, catalase, soybean

Introduction. Plants are exposed to a variety of adverse environmental influences at different stages of ontogeny. Extreme stresses cause various changes in plant cells. Abiotic stresses such as salinity, low temperatures, and drought are among the factors that affect plant growth and yield. These stresses disrupt the balance of oxidation reactions in plants, increase the production of reactive oxygen species in plant cells, and create oxidative stress. [3] Depending on the strength of abiotic stressing, the effects can be positive (adaptive) and negative (decreased photosynthetic activity, growth inhibition, accelerated aging and damage to plant organs) occurs.

Under the combined influence of biotic (viral infections) and abiotic (drought, temperature stress, heavy metal contamination, mechanical damage, etc.) stress factors in plants, oxidative "explosion" occurs with the accumulation of free radicals in the plant cell happens. Accumulation of free radicals in cells can lead to damage of various cell components, in particular, serious disruption of plant biochemical mechanisms due to lipid peroxidation of biological membranes. [2]

The antioxidant defense system resists the harmful effects of reactive oxygen species and free radicals. Antioxidant compounds reduce the oxidation intensity of free radicals. Controls their concentration in the cell.

Superoxide dismutase (SOD) is a key enzyme of the antioxidant system. Superoxide represents a group of metalloenzymes that catalyze the dismutation reaction of anion radicals, maintain their concentration in the cell at a low level, and reduce the likelihood of the formation of a more active single oxygen. Depending on the metal ion at the active center of the enzyme, several SOD isoenzymes differ: Cu, Zn, Mn, and Fe. Among them, Cu / Zn-SOD has the highest activity. [10]

Cu / Zn-SOD is one of the most common SOD isoenzymes in plant cells. Molecular mass 30-33kDa. The enzyme is located in the chloroplast, mitochondria, peroxisomes and apoplasts. The cytosolic form of Cu / Zn-SOD has been found to be near or above the tonoplast, as well as in the nucleus. SOD (up to 80%) in the nucleus binds to DNA filaments, protecting them from oxidative damage. MnSOD is found in the matrix of mitochondria and peroxisomes. FeSOD is located in the chloroplast and in the cytoplasm of some legumes (soybeans and beans). [9]

Scientists have identified 10 isoenzymes of SOD in various tissues of soybean plants, one of which is found in MnSOD stems and seeds, 4 Cu / Zn SOD isoenzymes are found in roots, stems and seeds, and 5 FeSOD isoenzymes are found only in leaves. [3]

Oxygen molecules are relatively inactive in a non-excitation state, and under the influence of the negative effects of biotic and abiotic stresses, metals or light quantum, which are formed as a result of anthropogen action (the use of pesticides), they are able to turn into free radicals. In the process of adaptation of plants to oxidative stress, the level of SOD content can increase depending on the type of plant, the stage of its development and the degree of stress. The presence of SOD isoenzymes ensures the plant's resistance to stress.[13]

Scientists have found that soybeans contain a large amount of peroxidase ferment in the seed coat.[15] peroxidase obtained from soy seed shells has a high temperature, an excessively high level of pH and a high reactivity compared to highly stable, organic and inorganic substrates in organic solvents, with a molecular mass ranging from 39 to 41 kDa.[2] peroxidase is an enzyme belonging to the class of oxidoreduktase, which, as an electronic donor, returns hydrogen peroxide to water using various substrates (phenols, amines, organic acids, glutathione, etc.).[14]

Peroxidase ferment has been found to play an active role in metobolism. One of the important properties inherent in the plant peroxidase enzyme is that it is subjected to the synthesis of lignin. In addition to lignification, indole-3-acetic acid, which is a plant hormone, is determined by the activity of peroxidase ferment in catabolism and ethylene biosynthesis.[8,16] plant peroxidase contains isoferments that exhibit many multifunctional properties, including growth, development, respiration, nitrogen metabolism, phytoalexin synthesis, lignin and suberin biosynthesis,[1,15] micorized formation, and participates in the neutralization of xenobiotics [14].

Studies show that peroxidase ferment in plants plays an important role in such physiological processes as cell wall metabolism, lignification, suberization, Aoxin metabolism, fruit growth and ripening, reactive oxygen species metabolism, self-defense against pathogens, resistance to salinity, wound healing.[1,4]

According to scientists, peroxidase is a stress agent, very sensitive to external factors, and in plants infected with various phytopathogens, growing in any mechanical influences, in various extreme conditions (in arid and saline soils), this enzyme manifests high activity.[11]

Catalases are antioxidant enzymes that catalyze the conversion of hydrogen peroxide into water and molecular oxygen. Catalases are divided into three classes according to the structure and sequence of amino acids. 1. Monofunctional or typical catalases 2.Catalase-peroxidase and Pseudocatalases, or Mn-catalases. [7] Under stressed conditions and oxidative stress, H_2O_2 is removed efficiently by Catalases[17]

Studies have shown that in soybean leaves infected with Septoria glycines Hemmi, the activity of enzymes that neutralize various adverse environmental factors, such as peroxidase, catalase, phosphatase, increased several times compared to the control (healthy leaves).

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