International Journal of Multidisciplinary Research and Growth Evaluation.

Research Progress on the Function of Selenium in the Whole Growth Process of Plants

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Article Info

ISSN (online): 2582-7138
Volume: 06
Issue: 03
May - June 2025
Received: 25-04-2025
Accepted: 28-05-2025
Page No: 1773-1775

Abstract
Selenium is an essential trace element for the human body, and humans can supplement selenium from plants. Selenium can promote the germination and growth of plant seeds, showing a typical biphasic effect of' low promotion and high inhibition'. Selenium plays a role in the whole growth cycle of plants by participating in regulating hormone levels and activating the enzyme activity system. In this paper, the effects of selenium on plant seed germination, growth and development, abiotic stress resistance and fruit quality were reviewed, and the effects of selenium on plant growth and metabolism and related physiological and biochemical indexes were analyzed. Future research needs to deeply analyze the interaction mechanism between selenium and other nutrient elements, and develop precision agriculture application technology to optimize the application strategy of selenium fertilizer, taking into account the improvement of crop yield and nutritional quality.

DOI: https://doi.org/10.54660/.IJMRGE.2025.6.3.1773-1775

Keywords: Selenium, Seed Germination, Growth and Development, Abiotic Stress, Fruit Quality

1. Introduction
Selenium is a rare non-metal, red or gray, brittle and easy to oxidize. It is known as the "king of cancer prevention " in human trace elements, and plays an important role in maintaining the health of the immune system and reducing the risk of cancer and cardiovascular disease [1, 2]. Selenium mainly exists in two forms: inorganic selenium and organic selenium. Common inorganic selenium has sodium selenite, selenate, etc., and has strong stability. It is often used as a raw material for selenium supplements; organic selenium, such as selenomethionine and selenoprotein, has high bioavailability, low toxicity and is easily absorbed by organisms. Studies have shown that inorganic selenium can be converted into organic selenium in plants, and organic selenium is directly absorbed by plants to meet the growth and development of plants [3]. Whether it is monoembryonic or polyembryonic seeds, an appropriate amount of selenium can promote plant germination by participating in the synthesis of substances in plant cells and participating in certain expression regulation [4-6]. In the aspect of regulating plant growth and development, selenium has a positive effect on plant growth and development by measuring physiological indexes such as root length, root activity, plant height and photosynthetic rate. The ability of plants applying exogenous selenium to resist abiotic stress is greatly increased compared with plants not applying exogenous selenium.

2. Effects of selenium on plant seed germination
At present, the germination rate, germination potential, amylase activity and soluble protein in the process of plant germination are mainly detected by selenium soaking treatment, and the effects of various forms of selenium on plant seed germination are explored [7]. Studies have shown that high concentrations of selenium induce oxidative stress in plants, resulting in inhibition of radicle elongation. Low concentration of selenium generally promotes seed germination. Selenium breaks seed dormancy by regulating GA / ABA hormone balance, and promotes seed amylase activity to enhance seed germination activity [8]. A large number of studies have shown that different plant seeds have different degrees of tolerance to selenium during germination.

3. The effect of selenium on plant growth and development

Selenium application is a necessary means to improve the selenium content in edible parts of plants [9]. Compared with soil application of selenium, foliar application of selenium is more conducive to the effective enrichment of selenium in crops [10, 11]. Many studies have shown that selenium has a significant impact on plant growth and development. The chlorophyll content, photosynthesis and growth morphology of plants are regulated by the effect of selenium concentration [12-14]. The plants applying a certain amount of selenium fertilizer showed the performance of increasing production, promoting root and seedling growth [15]; however, excessive application of selenium fertilizer will inhibit plant growth, destroy chloroplast structure, reduce photosynthetic efficiency and affect chlorophyll synthesis. At the same time, the sensitivity and response of different crops to selenium concentration are different. For example, the plant height, leaf length and dry weight of oat seedlings increased under low concentration of Na_2SeO_3 treatment, but the root length decreased. Under different selenium concentrations, the changes of main root length and lateral root number of rices are different, and high concentration of selenium will significantly reduce the growth rate [15].

4. Effects of selenium on plant resistance to abiotic stress

With the deterioration of ecological environment and climate, it is more and more important to enhance the resistance of plants to adversity stress. Studies have shown that selenium has an excellent effect on improving the stress resistance of plants [16]. Superoxide dismutase (SOD) is one of the most important antioxidant enzymes in organisms and an important indicator of plant stress resistance measurement. After foliar application of selenium, the activity of SOD in seeds increased, thereby enhancing the stress resistance of seedlings. Low concentration of selenium can induce the increase of catalase (CAT), SOD and peroxidase (POD) activities in roots and leaves of seedlings, and improve the adaptability of durum wheat under salt stress. Na_2SeO_3 can endow wheat with excellent tolerance under drought stress [17]. Selenium also has a unique potential in enhancing plant heavy metal tolerance. In the cadmium stress experiment, exogenous selenium reduced the MDA content of mustard seeds and alleviated the damage caused by Cd to mustard seed germination [18].

5. Effect of selenium on fruit quality

A large number of studies have shown that selenium can effectively improve fruit quality, which also depends on the concentration effect. The chlorophyll content index (CCI) value of citrus treated with selenium fertilizer was significantly higher than that of CK group, that is, selenium increased fruit maturity [19]. Selenium can promote the synthesis of soluble solids, soluble sugar, vitamin C and other organic substances in pears, thereby improving the taste of pulp [20]. By injecting selenium fertilizer into the stems of citrus trees, it was found that selenium could promote the growth of new leaves and shoots, increase the chlorophyll content of leaves, promote the synthesis of organic matter in kumquat fruits, and improve the quality of kumquat fruits [21]. In summary, an appropriate concentration of selenium can improve fruit quality by regulating the absorption of nutrients by plants and increasing the synthesis of organic matter, but the effect of high concentration of selenium is the opposite.

6. Conclusion and prospect

6.1 Main conclusions

Previous studies have shown that selenium has a significant effect on seed germination, growth and development, stress resistance and fruit quality of plants. Germination rate, germination potential, amylase activity and soluble protein content in germination stage, root activity, plant height and chlorophyll activity in growth and development stage, MDA, SOD, POD and CAT content in stress resistance research, vitamin C, soluble sugar and starch content in fruit in mature stage are important physiological and biochemical indexes.

6.2 Future research direction

Rational use of modern science and technology to explore the role of selenium in the whole growth cycle of plants. In addition, selenium also has a positive effect on human health, such as the treatment of tumors. Reasonable and safe application of selenium to environmental governance and human health has a broad development prospect. In the future, the research on selenium can be continued from the following directions:

- The effect of interaction between fungi and selenium on plant growth and development.
- Effect of selenium-enriched plants on selenium content of surrounding plants.
- The effect of selenium on the mechanism of flavonoid synthesis.
- The synergistic effect of selenium and vitamin E on the occurrence of human cancer.

Funding: This work was supported by Development of selenium-mediated disease resistance and fruit quality enhancement technology in citrus (HZ250018) and the Doctoral Research Initiation Fund of Jingchu University of Technology (YY202416).

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