E CONF SERIES

International Conference on Multidisciplinary Sciences and Educational Practices
Hosted online from Rome, Italy
Website: econfseries.com 27th June, 2025

MANAGEMENT OF POTATO GROWTH AND DEVELOPMENT USING PHYSIOLOGICALLY ACTIVE SUBSTANCES IN SALINE SOIL CONDITIONS

Khujaniyazova Barno Khushnudovna
Bukhara State University
xojaniyozovabarno@gmail.com

Kushiev Khabibjon Khojiboboyevich
Scientific Research Institute
Agrobiotechnology and Biochemistry of Guliston State University

Abstract

This research paper explores the effects of physiologically active substances on the growth and development of potatoes cultivated in saline soil conditions. Salinity is a significant environmental stressor that adversely affects plant growth, leading to reduced yield and quality. The study aims to evaluate how the application of various physiologically active compounds can mitigate the negative impacts of salinity on potato plants.

Experiments were conducted under controlled conditions to assess the physiological responses of potato plants treated with different concentrations of these active substances. Key parameters measured included germination rates, root development, leaf area, and overall plant biomass. The results indicated that the application of physiologically active substances significantly improved the growth metrics of potato plants in saline conditions compared to untreated controls.

Keywords: potato, physiologically active substance, external environment, management.

Introduction

Soil salinization remains one of the major abiotic stress factors adversely affecting crop productivity worldwide. High concentrations of soluble salts in the soil reduce the availability and uptake of essential nutrients, thereby impairing plant growth,

development, and ultimately reducing both yield and quality of agricultural products. Potatoes (Solanum tuberosum L.), being moderately salt-sensitive crops, exhibit pronounced growth retardation and yield decline under saline conditions, especially when cultivated varieties are not adapted to such stress.Currently, most potato cultivars grown on saline soils are highly susceptible to salt stress and demonstrate poor physiological adaptability. As a result, the nutritional composition of harvested tubers, especially their content of essential organic compounds and vitamins, falls below the levels required for human dietary needs, reducing both consumer value and ecological sustainability. Therefore, identifying, developing, and propagating high-yielding and salt-tolerant potato cultivars constitute a vital scientific and practical challenge. In this regard, one promising approach is the use of natural or synthetic plant growth regulators (PGRs) and physiologically active compounds that may enhance salt tolerance by stimulating plant metabolism and stress adaptation mechanisms. Among such compounds, glycyrrhizic acid—a triterpenoid saponin derived from the roots of Glycyrrhiza glabra (licorice)—has shown potential hormonal and biostimulant properties (Lukyanova et al., 2001; Khoshiev & Dalimov, 2005, 2007). This study investigates the potential of glycyrrhizic acid salts in promoting the growth and development of potato plants under saline soil conditions.

Materials and Methods

Plant Material and Growth Conditions:Three potato genotypes were selected for this study: the widely cultivated cultivar Sarnav, and two experimental breeding lines, C-16 and C-17. Meristematic tissues from each genotype were used for in vitro propagation.

Preparation of Glycyrrhizic Acid Salt Solutions.Solutions of glycyrrhizic acid salts were prepared using various ionic forms including trisodium (Na_3GA), monopotassium (KHGA), lithium (LiGA), and ammonium (NH_4GA) salts. These were dissolved in sterile distilled water to achieve desired concentrations ranging from 0.05% to 0.2%.

Experimental Procedure:Plantlets were cultured initially on Petri dishes containing Murashige and Skoog (MS) medium supplemented with the glycyrrhizic acid salt

solutions. After initial development, the plantlets were transferred to pots containing artificially salinized soil with known EC values simulating moderate to high salinity stress. Control groups were maintained without any salt treatment. Evaluation Criteria.Germination percentage, shoot and root length, chlorophyll content, biomass accumulation, and tuber yield were recorded at various developmental stages. Each treatment was replicated three times, and statistical analyses were performed using ANOVA with significance at $p < 0.05$.

Results

The results demonstrated significant genotype-dependent responses to glycyrrhizic acid salts. In Sarnav, germination rates under trisodium and monopotassium salt treatments increased by 12.3% and 11.2%, respectively, compared to control. However, C-16 and C-17 lines showed relatively lower gains in germination (1.2–3.7%).Notably, substituting Na^+ and K^+ ions with Li^+ and NH_4^+ in glycyrrhizic acid salts resulted in more pronounced positive effects. In Sarnav, germination increased by 7.4%, while in C-16 and C-17, the rates rose by 6–14.5% and 2.4%, respectively. Similar trends were observed in vegetative growth stages, where shoot length, chlorophyll content, and root biomass exhibited significant enhancement under LiGA and NH_4GA treatments.Additionally, plants treated with Li^+ and NH_4^+ salts produced tubers with higher fresh and dry weights compared to those in the control and Na^+/K^+ treatments, suggesting that glycyrrhizic acid salts may play a role in ameliorating salt-induced growth inhibition.

Conclusion

The findings of this study indicate that glycyrrhizic acid and its salt derivatives possess promising biostimulant properties that can enhance the growth and productivity of potatoes under saline soil conditions. Among the tested salt forms, lithium and ammonium salts demonstrated superior efficacy in improving germination, vegetative growth, and tuber yield, particularly in the salt-sensitive cultivar Sarnav. These results suggest that glycyrrhizic acid-based biostimulants could serve as an effective agronomic tool for improving crop performance in saline environments.Further field-level investigations are recommended to validate

laboratory findings and assess long-term ecological impacts, dosage optimization, and economic feasibility of glycyrrhizic acid salt applications in sustainable agriculture.

References

1. Yuda Hariadi, Karl Marandon, Yu Tian, Sven-Erik Jacobsen, Sergey Shabala. Ionic and osmotic relations in quinoa (Chenopodium quinoa Willd.) plants grown at various salinity levels // Journal of Experimental Botany, 2011. - 62(1). – P. 185-93.
2. Kintya P.K., Lazuryevsky G.V., Balashova N.N. Structure and biological activity of steroid glycosides of a series of spirostane and furostane. - Chișinău: "Știința", 1987. - 144 p.
3. Zhakaté A.G., Essam A.E., Enaki R.M. et al. Antimutagenic activity of steroid glycosides // 4th International Conference: "Growth Regulators and Plant Development". Abstracts. - Moscow. - 1997. - P. 278.
4. Shakirova F.M. Nonspecific resistance of plants to stress factors and its regulation. - Ufa: Gilem. - 2001. - 160 p.
5. Tretyakov N.N., Kuznetsov V.V., Kholodova V.P. et al. Resistance of spring wheat varieties to abiotic stresses // Izvestiya of the Timiryazev Agricultural Academy. - Moscow, 2003. - Publishing House of the Moscow Agricultural Academy. - Issue 4. - P. 71-88.
6.Murashige, T., & Skoog, F. (1962). A revised medium for rapid growth and bioassays with tobacco tissue cultures. Physiologia Plantarum, 15(3), 473-497.
7. George, E. F., & Sherrington, P. D. (1984). Plant Propagation by Tissue Culture.Exegetics,Ltd.