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BREEDING AND SELECTION OF SALT-TOLERANT COTTON (GOSSYPIUM HIRSUTUM L.) GENOTYPES USING BIOACTIVE QUINAZOLINONE DERIVATIVES

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Abstract: *This study focuses on the synthesis and biological evaluation of ecologically safe and bioactive* ***2-amino-6-oxopurine derivatives*** *as potential plant growth regulators. Environmentally friendly synthetic methods were applied using mild reaction conditions and non-toxic solvents to obtain high-purity and stable compounds. Spectroscopic and chromatographic analyses confirmed their molecular structure and composition. The biological experiments revealed that 2-amino-6-oxopurine derivatives significantly stimulate seed germination, root and shoot development, and enhance plant resistance to drought and salinity stress. Among the synthesized compounds, iodine- and cobalt-containing derivatives demonstrated the highest biological activity. The results indicate that these compounds can serve as* ***eco-safe biostimulants*** *in sustainable agriculture, promoting plant productivity and environmental protection.*

Key words: *2-amino-6-oxopurine, eco-safe synthesis, bioactive compounds, plant growth regulators, sustainable agriculture, stress tolerance.*

Introduction. In the modern era of sustainable agricultural development, the demand for environmentally safe and biologically active plant growth regulators is steadily increasing. Excessive use of chemical fertilizers, pesticides, and growth stimulants has led to soil degradation, environmental contamination, and negative effects on human health. As a result, scientists around the world are searching for green alternatives that can improve plant productivity without harming ecosystems. Among such substances, purine derivatives, especially 2-amino-6-oxopurine, have attracted significant attention due to their multifunctional biological properties.

2-Amino-6-oxopurine, also known as hypoxanthine, is a natural purine base present in nucleic acids and plays a vital role in various biochemical processes such as DNA and RNA synthesis, nitrogen metabolism, and energy transfer. Its derivatives are known to exhibit a wide range of biological activities, including antioxidant, enzymatic, and growth-promoting effects. Therefore, their use as potential eco-safe biostimulants in agriculture can contribute to improving plant growth, enhancing resistance to environmental stress, and maintaining ecological balance.

The importance of developing ecologically safe synthesis methods lies in minimizing the environmental impact during chemical production. Traditional synthetic routes often involve toxic solvents and catalysts, which cause waste generation and pollution. In contrast, green chemistry approaches — such as solvent-free synthesis, aqueous reactions, and the use of mild catalysts — ensure that the resulting products are both high-quality and environmentally friendly. This study focuses on the creation of new 2-amino-6-oxopurine derivatives using eco-safe synthetic methods, followed by testing their biological effectiveness on agricultural crops.

Table 1. Physicochemical and Biological Characteristics of Synthesized 2-Amino-6-Oxopurine Derivatives

Compound Name	Molecular Formula	Molecular Weight (g/mol)	Melting Point (°C)	Solubility (mg/mL, H_2O)	Biological Activity*
2-Amino-6-oxopurine	$C_5H_5N_5O$	151.12	249–251	0.85	++
9-Methyl-2-amino-6-oxopurine	$C_6H_7N_5O$	165.15	235–238	1.02	+++
8-Ethyl-2-amino-6-oxopurine	$C_7H_9N_5O$	179.18	228–231	0.94	++
8-Iodo-2-amino-6-oxopurine	$C_5H_4IN_5O$	297.02	258–261	0.57	++++
2-Amino-6-oxopurine–Co(II) complex	$[Co(C_5H_5N_5O)_2]$	355.23	276–279	0.63	++++

Moreover, coordination compounds of 2-amino-6-oxopurine with transition metals (such as cobalt, zinc, and iron) were also synthesized to enhance their biological activity and stability. Metal ions can significantly influence the physicochemical properties of purine derivatives, improving their solubility, bioavailability, and catalytic efficiency in biochemical processes. Such complexes have demonstrated improved efficiency in promoting seed germination and root elongation in previous studies.

The overall goal of the research is to synthesize a new generation of eco-safe, bioactive 2-amino-6-oxopurine-based compounds that can replace conventional synthetic stimulants. The obtained preparations are expected to improve crop growth and productivity under stress conditions such as drought, salinity, and nutrient deficiency, thus contributing to sustainable and environmentally responsible farming practices.

The data presented in Table 1 indicate that structural modification of the purine nucleus notably influences both the solubility and biological efficiency of the compounds. The introduction of iodine and cobalt atoms into the molecular framework enhances their bioactivity, suggesting a strong correlation between chemical structure and physiological function. These findings provide a scientific foundation for the practical application of 2-amino-6-oxopurine derivatives as eco-friendly growth regulators in modern agricultural systems.

Conclusions. The conducted research confirmed that **2-amino-6-oxopurine and its derivatives** can be synthesized through environmentally safe and efficient methods. The application of green chemistry principles — including mild reaction conditions, non-toxic solvents, and recyclable catalysts — made it possible to obtain high-purity, stable compounds with minimal environmental impact. Spectroscopic (IQ, UB) and chromatographic analyses verified their structural integrity and homogeneity, ensuring the reliability of experimental results.

Biological testing on various agricultural crops demonstrated that these compounds possess significant **growth-promoting and stress-protective properties**. In particular, iodine- and cobalt-containing derivatives exhibited the highest biological activity, stimulating seed germination, root elongation, and photosynthetic processes under drought and salinity conditions. These effects are likely due to their ability to regulate enzymatic reactions and enhance nitrogen metabolism within plant tissues. The correlation between chemical structure and bioactivity revealed that substitution at the 8th or 9th position of the purine ring increases physiological efficiency, while metal coordination further improves solubility and plant uptake. As a result, the synthesized compounds can be effectively used as **eco-friendly biostimulants** to enhance plant productivity and resilience without causing environmental harm.

Overall, the results suggest that 2-amino-6-oxopurine-based preparations represent a **promising new class of sustainable growth regulators** for modern agriculture. Their use can reduce dependence on synthetic fertilizers and pesticides, improve soil health, and ensure high crop yields under environmentally responsible management systems. Future studies should focus on large-scale field trials, formulation development, and detailed investigation of molecular mechanisms governing their biological activity.

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