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Mitigating Salt Stress in Wheat Using Indole-3-Acetic Acid: A Comprehensive Study

Muhammad Umar*

Department of Botany, Faculty of Sciences, University of Agriculture, Faisalabad

*Corresponding Author: **omarjaved4040@gmail.com**

ABSTRACT

Salt stress is a major abiotic factor that restricts plant growth and yield globally. The application of plant growth regulators such as Indole-3-Acetic Acid (IAA) has emerged as a potential strategy to combat these challenges. This study aimed to investigate the effectiveness of foliar-applied IAA in ameliorating the detrimental effects of salinity on wheat (*Triticum aestivum L.*) growth and yield parameters. A pot experiment was conducted under a Completely Randomized Design (CRD) to evaluate various concentrations of IAA under three salinity levels. The findings highlighted the potential of IAA in improving wheat growth and yield under salt stress conditions.

Keywords: Salt stress, Wheat, Indole-3-acetic acid

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Introduction

Wheat (*Triticum aestivum L.*) is one of the world's most important cereal crops, providing a significant portion of daily caloric intake for a large part of the global population. It is known for its high nutritional value, including protein, fiber, vitamins, and minerals. Despite its importance, wheat is highly susceptible to environmental stresses, particularly salinity, which affects approximately 20% of the world's arable land and is increasing due to climate change and human activities. Salinity stress hampers wheat germination, growth, reproductive development, and ultimately reduces yield. It leads to osmotic stress, ion toxicity, and oxidative damage, affecting cellular functions and photosynthetic efficiency. In response, researchers have focused on developing adaptive strategies to improve crop resilience. Plant growth regulators like Indole-3-Acetic Acid (IAA), a naturally occurring auxin, play a crucial role in plant development and stress response. Foliar application of IAA has shown promise in enhancing plant tolerance against abiotic stresses by improving root and shoot growth, nutrient uptake, and overall plant vigor [1].

Materials and Methods

A pot experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad, to evaluate the efficacy of IAA under salt stress conditions in wheat. The experimental design was a Completely Randomized Design (CRD) with four levels of IAA (0, 50, 100, 150 mg/L) and three salinity levels (0, 6, and 12 dS/m). IAA was applied foliarly at two growth stages: 30 and 48 days after sowing. Standard agronomic practices were followed throughout the experiment. Upon harvesting, data on various growth and yield parameters including root and shoot length, spike length, number of leaves and spikelets, grain yield, and biomass were recorded. The data were analyzed statistically using LSD at a 5% probability level.

Results and Discussion

Salinity had a detrimental impact on wheat growth, as evidenced by reductions in root and shoot lengths [2]. However, IAA application significantly mitigated these effects. The highest root length of 22.10 cm and shoot length of 56.77 cm were recorded at the highest IAA concentration, compared to the control values of 18.77 cm and 51.10 cm, respectively. Spike length also improved with IAA application, reaching 11.44 cm under the highest treatment. Leaf count and spikelet number showed slight, non-significant improvements. Notably, the number of seeds per spike increased from 12.33 to 16.11 with IAA application. Dry biomass, including shoot and root weights, was positively affected. The maximum dry shoot weight was 4.68 g, while the dry root weight peaked at 0.78 g. Grain yield was enhanced, with the highest recorded at 4.77 g, showing a clear advantage of IAA treatment under saline conditions. The harvesting index, a key yield efficiency indicator, increased from 0.83 to 0.99%, indicating better resource allocation towards grain formation. These results confirm that IAA improves wheat's salt tolerance by enhancing growth and physiological functions.

Conclusion

The findings from this study demonstrate that salinity significantly hampers wheat growth and productivity. However, the application of Indole-3-Acetic Acid (IAA) proved effective in mitigating the adverse effects of salt stress. IAA enhanced root and shoot development, increased grain yield and biomass, and improved the overall physiological performance of wheat plants. The study underscores the potential of IAA as a sustainable agronomic intervention to improve wheat productivity under saline conditions.

References

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