PREDICTION AND REGULATION OF COTTON YIELD VIA CONVOLUTIONAL NEURAL NETWORK-BASED SOFTWARE SOLUTIONS

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Abstract: *The research demonstrates that the combined application of biostimulants with chemical agents for pest and disease control significantly enhances cotton yield and fiber quality. Field experiments conducted in the Kashkadarya region of Uzbekistan showed that integrated treatment with Tandem biostimulant, Indoxacarb insecticide, and Zerox fungicide increased yield up to 39.2 c/ha in the Bukhoro-8 variety and 40.5 c/ha in the Marvarid variety, representing yield increases of 33.8% and 35% compared to control plots. The findings offer practical guidance for improving productivity and effective pest management in cotton farming through convolutional neural network-based software systems.*

Keywords: *cotton yield prediction, precision agriculture, convolutional neural networks (CNN), pest detection, biostimulants, crop protection, yield optimization*

INTRODUCTION

Cotton is one of the most important agricultural crops in Uzbekistan and plays a significant role in the national economy. Improving cotton productivity while protecting plants from diseases and insect pests remains a major challenge in modern agriculture. In recent years, convolutional neural networks (CNNs) have become increasingly important in precision agriculture because they allow automatic disease detection, pest monitoring, and yield prediction with high accuracy.

This study investigates the application of convolutional neural network-based software solutions for predicting and regulating cotton yield under field conditions in the Kashkadarya region of Uzbekistan. Particular attention is given to the effectiveness of integrated treatments using biostimulants, insecticides, and fungicides on cotton varieties.

Materials and Methods

The field experiments were conducted in the Kashkadarya region of Uzbekistan during the cotton growing season. Two cotton varieties were selected for the study: medium-fiber Bukhoro-8 and fine-fiber Marvarid. The experiments were carried out

according to the recommendations of the Ministry of Agriculture of the Republic of Uzbekistan and the State Research Production Center.

The major pests monitored during the study included cotton bollworm (Thrips tabaci), aphids (Aphis craccivora, Acyrthosiphon gossypii), and other insect pests affecting cotton vegetative and generative organs.

Chemical treatments included the application of Tandem biostimulant (0.5 l/ha), Indoxacarb insecticide (0.7 l/ha), Zerox fungicide (1.5 l/ha), and their combined application. A convolutional neural network-based software system was developed for monitoring pest infestation and predicting cotton yield using plant images collected from field cameras and UAVs.

Pic. 1. Precision Cotton Farming with Integrated Pest and Yield Monitoring Systems

Pest infestation levels and the number of damaged cotton elements were recorded before treatment and 20 days after chemical application. Yield measurements were obtained at the end of the harvesting season.

Results and Discussion

The results demonstrated that the combined application of biostimulant, insecticide, and fungicide significantly reduced pest infestation compared to untreated control plots and individual treatments. The CNN-based software system successfully identified damaged plant organs and classified pest infestation levels with high accuracy.

The highest effectiveness against cotton pests was observed in plots receiving combined treatment. Significant reductions were recorded in aphid populations and cotton bollworm damage. The software system enabled early pest detection and timely treatment recommendations.

In the Bukhoro-8 variety, the combined treatment produced the highest yield of 39.2 c/ha, representing a 33.8% increase compared to control plots. The Marvarid variety also demonstrated substantial productivity improvement, reaching 40.5 c/ha, or 35% higher than the control.

The use of CNN-based software solutions improved agricultural efficiency by enabling automated pest detection, continuous crop monitoring, early disease diagnosis, accurate yield forecasting, and optimization of pesticide application. The integrated use of biostimulants, fungicides, and insecticides improved plant growth, reduced crop damage, and enhanced cotton productivity under the climatic conditions of the Kashkadarya region.

Conclusion

The study confirms the effectiveness of convolutional neural network-based software systems for predicting and regulating cotton yield. The integrated application of Tandem biostimulant, Indoxacarb insecticide, and Zerox fungicide significantly reduced pest infestation and improved cotton productivity in both Bukhoro-8 and Marvarid varieties. The findings demonstrate that artificial intelligence technologies and precision agriculture systems can significantly improve sustainable cotton farming and pest management efficiency in Uzbekistan.

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