Commentary
Volume 14:4, 2023

Journal of Biosensors & Bioelectronics

ISSN: 2155-6210 Open Access

Advanced Biosensor for Early Detection of Yellow Rust Pathogen

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Introduction

Wheat yellow rust fungus is a biotrophic pathogen. Yellow rust can have an impact on grain quality, lowering protein content and yield. As an airborne infection, the spores may travel long distances by wind and can also be carried on animals and human clothes. Yellow rust is mostly found in temperate and marine habitats and the best temperature for infection and development is between 7 and 22 °C. Yellow rust, caused by the pathogen *P. striiformis*, is a significant threat to global wheat production [1]. Early detection and effective management of this pathogen are crucial to prevent yield losses and maintain food security. Conventional methods of detection often rely on visual symptoms, which appear after the infection has already established itself. Therefore, the development of an advanced biosensor for the early detection of *P. striiformis* is of paramount importance. This biosensor leverages multi-layer technology to detect the presence of the pathogen's unique biomarkers even before visible symptoms manifest. In this study, we present the design, working principle and potential impact of the advanced biosensor in revolutionizing the monitoring and management of yellow rust [2].

Description

The advanced biosensor utilizes a multi-layer approach to achieve early detection of *P. striiformis*. The sensor is designed to capture and identify specific biomolecules that are released by the pathogen during its early stages of infection. The biosensor consists of several layers, each serving a distinct function in the detection process. The outermost layer is designed to attract and bind to the pathogen's biomarkers [3]. This layer is carefully engineered to be highly selective, ensuring that only the target biomolecules are captured. Beneath the outer layer lies a transducer that converts the binding events into measurable signals. This transducer can be based on various principles such as optical, electrochemical, or piezoelectric, depending on the application. The transduction process generates a signal proportional to the concentration of the captured biomarkers, allowing for quantitative assessment of the infection intensity [4]. The biosensor's multi-layer architecture enhances its sensitivity and specificity. By focusing on early infection biomarkers, the biosensor can detect the presence of the pathogen before visible symptoms develop. This early detection capability enables farmers and plant health authorities to take timely preventive measures, reducing the spread of the disease and minimizing yield losses [5].

Conclusion

The development of an advanced biosensor for the early detection of *P. striiformis*, the causal agent of yellow rust, marks a significant advancement in plant disease management. By harnessing the power of multi-layer technology, this biosensor offers a reliable and rapid means of identifying the pathogen's presence even before visual symptoms become apparent. This early detection capability holds immense promise in enhancing agricultural productivity and ensuring food security. With its potential to revolutionize the monitoring and management of yellow rust, the advanced biosensor paves the way for a more sustainable and resilient approach to protecting global wheat crops. The suggested multilayer biosensor is made up of three modular layers that may be simply swapped out to detect different infections. Modularity can be achieved by changing the first layer's morphology to mimic the target crop, changing the feeding media (second layer) to be tailored towards the target pathogen and changing the third layer to detect the target analyte to signal the presence of the targeted pathogen. Furthermore, utilising the Internet of Things (IOT), the biosensor may be incorporated as part of a larger sensing network, leading to the development of an early illness detection and warning system. More work is needed to refine the nonenzymatic glucose sensor proposed in this paper.

Acknowledgement

None.

Conflict of Interest

There are no conflicts of interest by author.

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Received: 02 August, 2023, Manuscript No. jbsbe-23-111804; **Editor Assigned:** 04 August, 2023, PreQC No. P-111804; **Reviewed:** 16 August, 2023, QC No. Q-111804; **Revised:** 21 August, 2023, Manuscript No. R-111804; **Published:** 28August, 2023, DOI: 10.37421/2155-6210.2023.14.398

How to cite this article: Omar, Francis. "Advanced Biosensor for Early Detection of Yellow Rust Pathogen." *J Biosens Bioelectron* 14 (2023): 398.