



RNA Interference in Plant Immunity: A Molecular Defense Mechanism

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Introduction

Plants are constantly exposed to a variety of pathogens, including viruses, bacteria, fungi, and nematodes, which threaten crop productivity and global food security. Unlike animals, plants lack an adaptive immune system, relying instead on innate immunity and sophisticated molecular mechanisms to defend themselves. RNA interference (RNAi) has emerged as a critical pathway in plant immunity. This sequence-specific gene silencing mechanism enables plants to detect and degrade pathogen-derived RNA, limiting infection and providing a versatile strategy for enhancing disease resistance [1,2].

Discussion

RNA interference is mediated by small RNA molecules, primarily small interfering RNAs (siRNAs) and microRNAs (miRNAs). Upon pathogen invasion, double-stranded RNA (dsRNA) molecules, often produced by viruses or aberrant transcripts, are recognized by Dicer-like enzymes, which cleave them into siRNAs. These siRNAs are incorporated into RNA-induced silencing complexes (RISCs), guiding the complex to complementary target RNAs for degradation or translational inhibition. This process effectively suppresses pathogen gene expression and limits replication, forming a key layer of antiviral defense [3,4].

Beyond direct antiviral activity, RNAi contributes to defense against other pathogens. Plants can generate siRNAs targeting bacterial and fungal genes, disrupting pathogen virulence and colonization.

Cross-kingdom RNA interference has also been observed, where plant-derived small RNAs are transported into invading pathogens to silence essential genes, providing a proactive defense mechanism [5].

RNAi is tightly integrated with plant immune signaling networks. The production of siRNAs can be regulated by pathogen recognition receptors (PRRs) and resistance (R) genes, linking RNAi to both pattern-triggered immunity (PTI) and effector-triggered immunity (ETI). Hormonal pathways, such as those mediated by salicylic acid and jasmonic acid, further modulate RNAi responses, coordinating defense with stress adaptation and growth.

The potential applications of RNAi in agriculture are significant. Exogenous application of dsRNA molecules or genetically engineered crops expressing specific dsRNAs can confer resistance to viruses, fungi, and insects. This approach offers a precise, environmentally friendly alternative to chemical pesticides and broad-spectrum resistance strategies. Challenges include efficient delivery, stability of dsRNA molecules, and potential off-target effects, which require careful design and evaluation.

Conclusion

RNA interference represents a powerful molecular mechanism in plant immunity, enabling sequence-specific silencing of pathogen genes and contributing to antiviral, antibacterial, and antifungal defense. By integrating RNAi with innate immune signaling, plants achieve a dynamic and adaptive response to infection. Harnessing RNAi through biotechnology offers promising strategies for developing disease-resistant crops, enhancing food security, and reducing reliance on chemical pesticides, paving the way for sustainable agriculture.

References

- Ingadottir AR, Bjorgvinsdottir EB, Beck A, Baldwin C, Weekes C, et al. (2020) Effect of two different nutritional supplements on postprandial glucose response and energy- and protein intake in hospitalised patients with COPD: A randomised cross-over study. *Clin Nutr* 39: 1085-1091.
- Ogan N, Yildirim F, Süzen B, Baha A, Akpınar EE (2020) Does Nutritional Risk Screening 2002 Correlate with the Dyspnea Status of Patients with GOLD Stage C-D Chronic Obstructive Pulmonary Disease?. *Turkish Thorac J* 21: 49-53.
- Maia I, Peleteiro B, Xará S, Amaral TF (2017) Undernutrition Risk and Undernutrition in Pulmonology Department Inpatients: A Systematic Review and Meta-Analysis. *J Am Coll Nutr* 36: 137-147.
- Law S, Kumar P, Woods S, Sriram KB (2016) Malnutrition screening in patients admitted to hospital with an exacerbation of chronic obstructive pulmonary disease and its association with patient outcomes. *Hosp Pract (1995)* 44: 207-212.
- Vermeeren MA, Schols AM, Wouters EF (1997) Effects of an acute exacerbation on nutritional and metabolic profile of patients with COPD. *Eur Respir J* 10: 2264-2269.