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Self-eDNA: It's Potential Role in Biotechnology

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SUMMARY

Damage associated molecular pattern (DAMP) molecules with a normal physiological state inside the cell, but at the time of damage or infection is usually released to the extracellular media, indicating cell damage. The plant self-extracellular DNA (eDNA) is a new approach use as biotechnological molecules for plant disease prevention. Self-eDNA has gained importance due to its function of growth inhibition observed over a wide variety of organisms; this function is considered as a new strategy for biological control to obtain highly pathogen-specifc products, without wasting time and research resources. On the other hand, eDNA, as other DAMPs, could act as an immune response elicitor, which could conduce to a new approach for the protection of crops against pests.

INTRODUCTION

The genetic material can act as DAMP. DNA is the source of genetic information, but it can leave the cell to the extracellular space mainly during cell death, whether it is apoptosis or necrosis. Nuclear or mitochondrial fragmented DNA molecules that appear in the extracellular or cytosolic compartment indicates cellular dysfunction or damage, including loss of the integrity of nuclei, mitochondria, or whole cells. Therefore, the extracellular DNA (eDNA) acts as DAMP giving a danger signal that denotes damage or injury to the organism that in turn triggers the immune response. In general, nucleic acid fragments can represent DAMP or PAMP (Pathogen-associated molecular patterns) and activate immunity. Moreover, a recent report provides strong biological evidence for the role of eDNA as DAMP in plants (Duran-Flores and Heil, 2016).

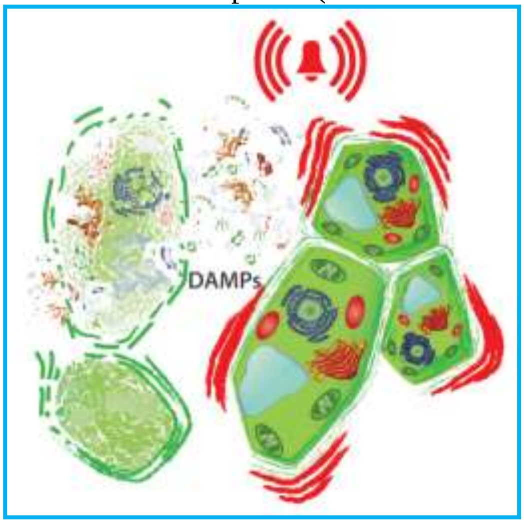

Fig. 1: Extracellular DNA are sensed by the neighbouring cell

In Fig. 1, the disintegration of cells (left) releases intracellular molecules to the extracellular space and exposes macromolecules to hydrolytic enzymes from which they are separated in the intact cell. In principle, all these delocalised and newly produced molecules can serve as damage-associated molecular patterns (DAMPs) that prepare the neighboring, intact cell (right) for enemy recognition and wound sealing (Heil and Land, 2014).

Based on the new function of self-eDNA, acting as DAMP, it has been proposed the use of this molecules for biotechnological. This new technology could have two possible ways of action (Fig. 2); the first one by generating a species-specific inhibitory effect on the organism from which it comes, using significant high self-eDNA doses, and the second one by inducing positive immune responses, by applicating low self-eDNA doses. The first approach represents a number of potential advantages in terms of drug development; once the pathogen is identified, the active molecule for its control is known a priori, being its own DNA. The second approach is based on the use of eDNA to generate a specific immune response that could lead stress tolerance (Ferrusquia-Jimenez *et al*., 2021)

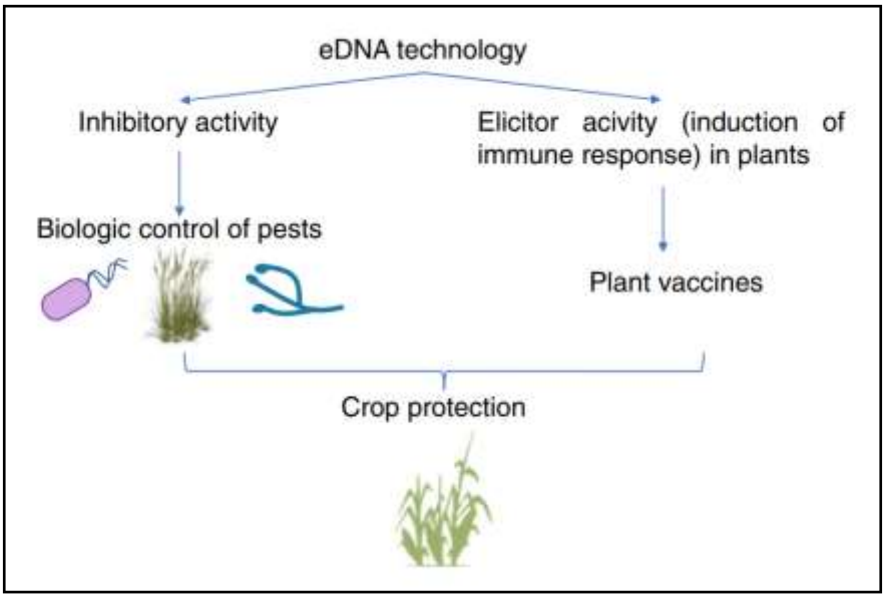

Fig. 2: Dual eDNA activity and its biotechnological potential

Based on the action of eDNA as DAMP, this technology could be used for the development of biologic control products and as plant vaccines. Using the technology for pest control the application of self-eDNA in doses ≥200 µg /mL is proposed, where the source of eDNA can be any type of soil pathogen or pest organism (bacteria, weeds, fungi). For immunity induction, as "plant vaccine" approach, doses <200 µg/mL could be used in developed plants (for example: four week plants).

CONCLUSION

The use of eDNA represents an interesting strategy of controlled elicitation that could be integrated to disease and pest management and considered as a natural and biodegradable alternative of biologic control. This type of eco-friendly alternatives suggests being the most accepted in the coming years given the serious problems that pesticide applications have globally generated.

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