Pesticide Pollution in the Caribbean:
A Cutting-Edge View on Sensors as an Alternative for Conducting Pesticide Residue Analysis

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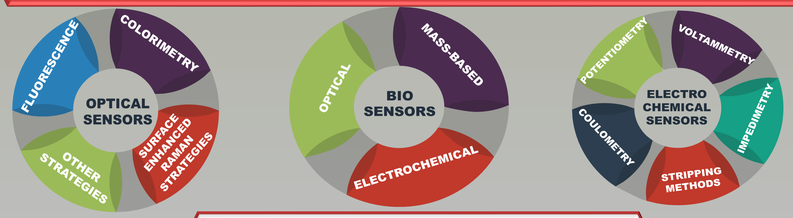
Aim

To provide an overview of the most viable reported performances of pesticide sensors and to highlight the challenges that need to be addressed in order to develop suitable sensors for the Caribbean.

Suitable Sensors for Pesticide Detection in the Caribbean



Advantages

- Facile, rapid, low cost approach
- Excellent future candidates for on site application
- Broad-based applicability

Challenges to be Addressed

- Deep research is desired to understand binding mechanism.
- Combination of computational methods, screen-printed techniques and statistical analysis is needed to offer portable, in-situ and multiple analyte detection without complex pre-treatment.
- Transition from laboratory stage to development of commercial sensors is required.
- More robust techniques are needed, to reduce sensitivity to harsh environmental conditions.

Zhao, G., Wang, H., & Liu, G. (2015). Advances in biosensor-based instruments for pesticide residues rapid detection. In International Journal of Electrochemical Science (Vol. 10, Issue 12).

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Background

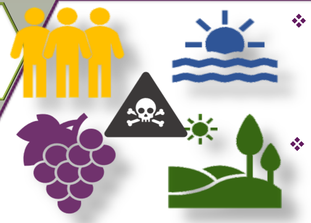
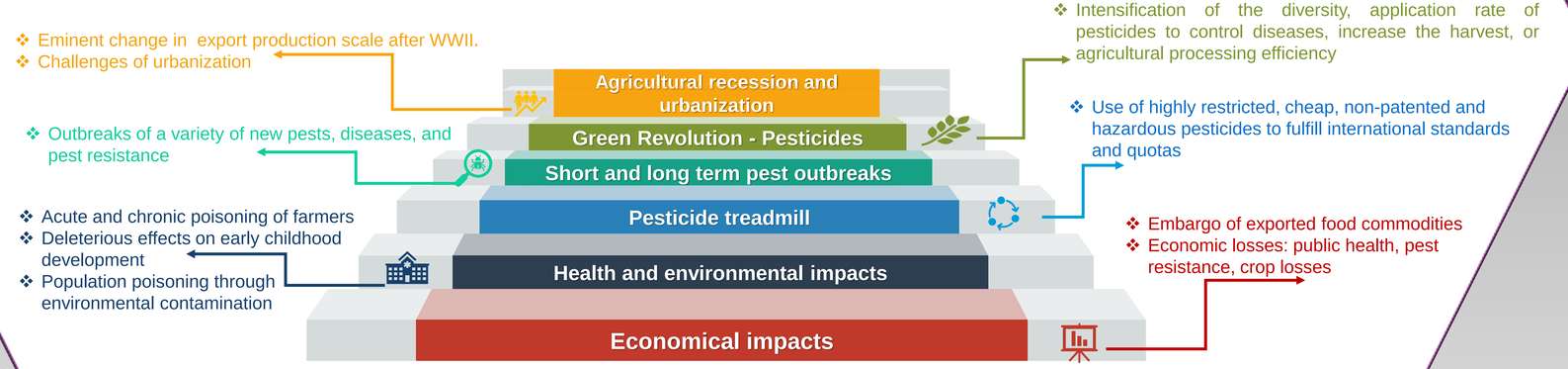


Fig 1. Pesticide poisoning of our society, waters, food, soil and waters

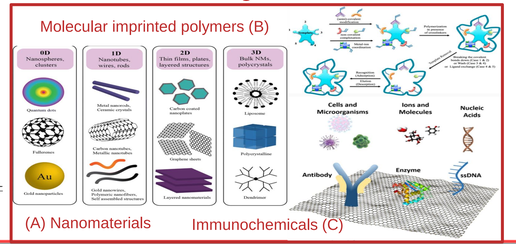
- Pesticide pollution prevalent in the Caribbean, is a matter of concern as these countries lack financial resources to continuously identify, quantify, and monitor these pesticides to safeguard the environment and public health.
  - Traditional pesticide residue analysis is based on sophisticated chromatographic techniques that provide excellent sensitivity, selectivity, and reproducibility towards these chemicals.
- Nevertheless, expertise, high sample preparation input, and good financial resources are required to operate and maintain these chromatographic systems, which confines their use for emergency, on-site and real time applications.
  - As a result, research has been devoted to alternative methods such as sensors that can conduct pesticide analysis in an easy, fast, sensitive, selective, accurate, and user-friendly way, which can be utilized in the Caribbean.

Evolutionary Roadmap – From Start to Present



Andreatta, S. L. (1998). Agrochemical exposure and farmworker health in the Caribbean: A local/global perspective. Human Organization. https://doi.org/10.17730/humo.57.3.e24073870707579h

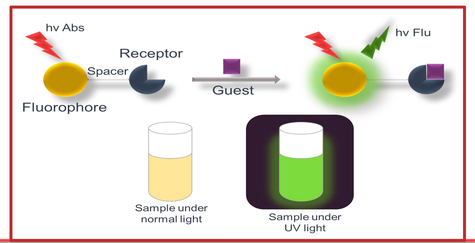
Most suitable recognition elements



Yılmaz, E., Garipcan, B., Patra, H., & Uzun, L. (2017). Molecular imprinting applications in forensic science. In Sensors (Switzerland) (Vol. 17, Issue 4). https://doi.org/10.3390/s17040691

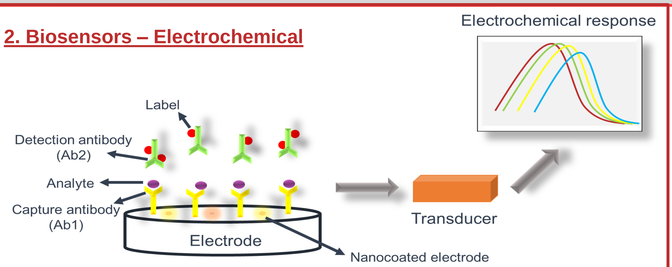
Poh, T., Ali, N., mac Aogáin, M., Kathawala, M., Setyawati, M., Ng, K., & Chotirmall, S. (2018). Inhaled nanomaterials and the respiratory microbiome: Clinical, immunological and toxicological perspectives. Particle and Fibre Toxicology, 15(1). https://doi.org/10.1186/s12989-018-0282-0

1. Optical sensors – Fluorescence



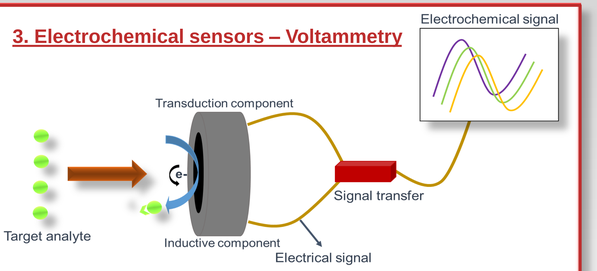
Wan, J., Zhang, X., Zhang, K., & Su, Z. (2020). Biological nanoscale fluorescent probes: From structure and performance to bioimaging. In Reviews in Analytical Chemistry (Vol. 39, Issue 1). https://doi.org/10.1515/revac-2020-0119

2. Biosensors – Electrochemical



Jiang, X., Li, D., Xu, X., Ying, Y., Li, Y., Ye, Z., & Wang, J. (2008). Immunosensors for detection of pesticide residues. In Biosensors and Bioelectronics (Vol. 23, Issue 11). https://doi.org/10.1016/j.bios.2008.01.035

3. Electrochemical sensors – Voltammetry



Du, H., Xie, Y., & Wang, J. (2021). Nanomaterial-sensors for herbicides detection using electrochemical techniques and prospect applications. In TrAC - Trends in Analytical Chemistry (Vol. 135). https://doi.org/10.1016/j.trac.2020.116178

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