Project title: Low cost, high-throughput electrochemical plant phenotyping platform for pesticide screening

Lead Supervisor and Department: Firat Guder, Department of Bioengineering

Co-Supervisor(s) and Department(s): Tolga Bozkurt, Life Sciences; Lukas Spichal (CATRIN – if external supervisors are permitted)

Project Description:

The agricultural sector urgently needs new tools to accelerate the discovery and assessment of sustainable pesticide alternatives while reducing environmental harm. Conventional pesticide development is slow and costly: identifying effective compounds from thousands of candidates can take over a decade, with extensive laboratory and field testing required. At the same time, pesticide resistance and overuse are driving biodiversity loss, soil degradation, and water pollution. There is therefore a critical need for innovative, rapid, and low-cost technologies to enable earlier, data-driven decision-making in pesticide discovery and regulation.

This PhD project will develop a high-throughput electrochemical phenotyping platform that combines real-time electrochemical sensing with artificial intelligence (AI) to monitor plant physiological responses to pesticide exposure. The system non-invasively measures electrochemical signatures from the root environment of plants, allowing early detection of physiological stress long before visible symptoms appear. By training machine learning algorithms on these time-resolved electrochemical datasets, the system can rapidly predict plant susceptibility to pesticides, providing an entirely new modality for phenotypic screening. While this project will place particular emphasis on herbicide screening, the underlying technology is broadly applicable to other pesticide categories, including insecticides, fungicides and bactericides, offering a powerful general tool for evaluating new active ingredients and biological alternatives.

Through this project, the student will gain interdisciplinary experience across bioengineering, plant science, and environmental data analytics. They will develop skills in experimental design, microelectronic systems, and the interpretation of complex biological data using AI and statistical approaches. The project will also provide exposure to translational research and sustainable agri-tech innovation, including the opportunity to collaborate with industrial and academic partners engaged in pesticide discovery and environmental monitoring. The student will acquire transferable expertise in quantitative experimentation, data modelling, and the development of low-cost analytical technologies applicable across multiple environmental and life-science domains.

To apply:
Please email f.guder@imperial.ac.uk with the following documentation:
- Statement of Purpose
- Your CV
- At least two references must be emailed to *Firat Guder* (by the referees)