PhD Project Advertisement

Project No/title: FBS2026 65 Ryalls rc / *Silicon-Improved Leafy Kale (SILK): Boosting shelf life, insect resistance, odour profiles and consumer preference*

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Ms Kate Finlayson, Orion FT

Project Details

Kale is a popular, nutrient-packed vegetable grown in the UK, but it often wilts quickly after harvest, develops unpleasant smells (i.e. volatile organic compounds, or VOCs), and gets damaged by pests like caterpillars before picking. This leads to a lot of food waste and lower quality for shoppers. Silicon (Si) is a safe, affordable natural additive that plants can absorb to make their leaves tougher and healthier. Past studies show it can help similar vegetables last longer and fight off bugs better by changing how they smell and grow. However, we don't fully know how it works for kale, especially on taste and smell that affect what people buy. This project will test Si's effects to make kale more sustainable, reduce waste in the food chain, and help UK farmers produce better crops.

Research aims: How does Si supplementation affect kale's pre- and post-harvest quality, specifically pest (*P. brassicae*) resistance, VOC profiles, shelf-life, and consumer preference?

Objectives:

1. Quantify pre-harvest effects on growth, VOCs, pest resistance, molecular responses.
2. Characterise post-harvest VOCs influenced by Si and damage.
3. Evaluate shelf-life and consumer preference, correlating attributes.

What you will do:

- The student will grow different kale varieties in glasshouses at the University of Reading, applying silicon through watering. They will measure plant size, silicon levels using X-ray fluorescence (XRF), and collect smell samples for detailed chemical analysis with advanced equipment (GCxGC-TOF-MS).
- Insect feeding tests will check pest damage on treated vs. untreated plants.
- For genetic studies, the student will extract RNA from leaves, prepare samples for sequencing, and use computer tools to spot changes in defence and smell-related genes.
- After harvest, they will store kale under commercial conditions, track spoilage (e.g. weight loss, freshness), analyse evolving smells, and run sensory evaluation sessions.
- Finally, the student will organize panels with people rating appearance, texture, and smell, then connect all data using stats software to find patterns.

References:

1. Johnson *et al.* (2024). Plant silicon defences suppress herbivore performance, but mode of feeding is key, https://doi.org/10.1111/ele.14519
2. Giordano *et al.* (2024). Assessing baby leaf kale (Brassica oleracea) waste production mitigation in the transition to sustainable packaging with the application of silicon through an integrative model of quality, https://doi.org/10.1016/j.crfs.2024.100881
3. Leroy *et al.* (2019). Silicon and plant natural defenses against insect pests: Impact on plant volatile organic

compounds and cascade effects on multitrophic interactions, https://doi.org/10.3390/plants8110444
4. Islam *et al.* (2025). Harnessing plant silicon defenses for biological control of herbivorous insects, https://doi.org/10.1016/j.tplants.2025.03.004
5. Goel *et al.* (2025). Shelf-life extension of green leafy vegetables through minimal processing: Special emphasis on the use of novel techniques, https://doi.org/10.1016/j.jafr.2025.101703

Student profile

Essential for project: A background in one or more of: biological sciences, agricultural sciences, food science, or chemistry.
Desirable for project: Prior experience in plant growth experiments, chemical analysis, bioinformatics, or taste testing. Training will be provided to build these skills if needed.
Minimum requirements for all FoodBioSystems applicants: An upper 2nd class degree (or equivalent) in a subject relevant to the project. Candidates with a lower class of Bachelors degree, but merit or above at Masters level will also be considered**.** Demonstrable skills in problem-solving, team-working, communication and time management.

Training

Project specific training opportunities: The student will receive hands-on training in growing plants and running insect tests in year 1 to build agronomy skills. They will learn advanced odour sampling and chemical analysis (GCxGC-TOF-MS) at Reading, plus gene sequencing preparation and computer-based bioinformatics at Cranfield's high-performance facilities during short visits (1-2 weeks). Sensory evaluation training will cover running taste panels. A placement at Orion FT will provide industry experience in applying silicon products and real-world crop management. External workshops on odour detection and data software will fill any gaps, boosting skills in sustainable food technology for future jobs.

FoodBioSystems training opportunities: Throughout their studentship, all FoodBioSystems doctoral researchers participate in cohort training that covers four key themes: food systems, big data (data analytics and modelling), business, and research fundamentals. All doctoral researchers complete a placement: either project-related with a non-academic (CASE) partner, or unrelated to the project and outside the academic environment (PIPS). Details of training are available on the DTP website: https://research.reading.ac.uk/foodbiosystems/training/.

Project supervision style

Fortnightly meetings with the full supervisory team (Ryalls, Magwaza, Bell, Finlayson) will focus on detailed progress updates, goal setting, and personalised guidance to address any challenges promptly, held in-person, or virtually/hybrid for accessibility. Monthly lab group meetings at the University of Reading will encourage input from fellow students, collaborative problem-solving, and exposure to diverse perspectives within the School of Agriculture, Policy and Development (SAPD). The student will be part of the Sustainable Land Management team, a supportive academic community within SAPD, and they will have access to the crop and food science networks across the university. Annual formal progress reviews will align with university requirements, incorporating career planning. Feedback on drafts will be provided within two weeks to maintain momentum, while immediate discussions on results will facilitate real-time adjustments. Support will be available for urgent issues, with an aim to promote flexibility and independence as the research evolves.

Stipend (Salary)

FoodBioSystems DTP students receive an annual tax-free stipend (salary) that is paid in instalments throughout the year. For 2025/26 this is £20,780 and it will increase slightly each year at rate set by UKRI.

Equity Diversity and Inclusion

The FoodBioSystems DTP is committed to equity, diversity and inclusion (EDI), to building a doctoral researcher (DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website and include:

- Offering reasonable adjustments at interview for shortlisted candidates who have disclosed a disability or specific learning difference.
- Guaranteed interview and applicant mentoring schemes for applicants, with UK home fees status, from eligible under-represented ethnic groups who also meet academic eligibility criteria and the student profile essential for the project.

These are opt-in processes**.**

Our studentships can be offered to home students on a part-time basis, and studentship end date and stipend payments will be amended to reflect the part-time registration. The minimum registration for DTP funded part-time students is 0.5 FTE (studying an average of 20 hours per week over 8 years). We regret that part time registration is not available to international students due to complexities of visa restrictions.

Funding note

We welcome applications from candidates with Home/ROI fees and international fees status. This studentship is funded by UKRI and covers stipend, fees at Home/ROI rate, and research costs.
Costs that must be found from other sources or met by the individual student include:
The difference between international and Home/ROI fees at University of Reading, visa fees, healthcare surcharge, relocation costs and guarantor services.
Information about fees is available at https://www.reading.ac.uk/doctoral-researcher-college/funding/fees/fees-new-students

For up to date information on funding eligibility, studentship rates and part-time registration, please visit the FoodBioSystems website.