PhD Project Advertisement

Project title: Predicting and understanding potato dormancy under interacting pre-harvest and postharvest conditions: a prerequisite for molecular breeding
Project No: FBS2022-11-Alamar-ca

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Project description:

In the UK, potato tubers are stored for up to 9 months to ensure year-round availability. One third of ware potatoes (*ca*. 1 Mt) are stored and destined for the processing industry each season. Overall losses of 17% (0.8 Mt) were recorded in 2012 with premature sprouting as one of the major causes of wastage[1,2]. Maintaining ecodormancy (sprout suppression due to external factors), combined with low reducing sugars, is essential for end-product quality. Current storage practices for processing potatoes rely on temperature control and sprout suppressant chemicals to control sprouting, cold-induced sweetening, and associated processing defects (i.e. crisps browning). However, the ban in 2020 of the chemical sprout suppressant CIPC (chlorpropham) has left the potato processing industry in need of effective and sustainable ways to maintain potato ecodormancy and delay sprouting. Recently, the use of the ethylene analogue and perception inhibitor 1-methylcyclopropane (1-MCP) in combination with ethylene has been developed to extend ecodormancy[3]. It is known that pre-harvest factors affect potato storage potential, but the mechanisms are not understood. Therefore, there is an opportunity to enhance the efficacy of postharvest control strategies via a greater understanding of interactions between pre-harvest environmental factors and postharvest potato physiology.

Long endodormancy is a desirable trait and variation exists in tetraploid cultivars and diploid mapping populations[3,4,5] yet there is a lack of research on its genetic control and environmental interactions. As such there is a need for structured data sets to link growing conditions with postharvest dormancy traits in different genetic and ploidy level backgrounds.

Recently, potato genetics received a boost by the development of homozygous inbred lines which provide excellent material for advanced genetic studies. Here we propose to (i) take the first vital steps for dormancy marker assisted selection (MAS), by understanding and modelling the control of dormancy in potential parental lines for mapping populations, paying attention to pre-harvest to postharvest transitions and interactions; (ii) develop a predictive model to estimate dormancy in store, considering pre- and postharvest factors, and genetic markers.

The student will:

1) Screen diploid and tetraploid lines for tuber endodormancy over typical storage timeframes.
2) Determine the impact of pre-harvest factors and postharvest strategies on dormancy.
3) Identify genetic factors controlling dormancy.
4) Develop predictive models for dormancy as determined by pre- and postharvest factors in known genotypes.

A better mechanistic understanding of potato dormancy where both pre- and postharvest cues are integrated will improve management of potato storage by allowing postharvest strategies to be tailored to preharvest history. The outputs of this project will also be used in potato breeding programmes to develop new cultivars with enhanced dormancy traits, which will in turn not only protect the supply chain from losses due to premature sprouting, but reduce GHG emissions associated with tuber and quality losses (wasted field, postharvest and processing inputs).

Training opportunities:

The student will have in-house training at Cranfield and Aberystwyth to improve their writing, public speaking, and employability skills. They can enrol in two-week MSc modules: 'Postharvest Technology' and 'Machine Learning for Metabolomics' as part of the MSc in Food Systems Management and MSc in Applied Bioinformatics, respectively.

Placements will be provided by both PepsiCo and Solynta. PepsiCo, through its Agro Discovery team, has extensive experience in applied crop physiology and agronomy. The student will have access to PepsiCo R&D expertise in these areas. A key aspect of the student experience will be the development of an understanding of how fundamental and applied research feeds into commercial practice.

The student will join the Solynta R&D programme, to obtain experience with genetic research and the application in a commercial context. They will be part of a team of in-house PhD students that are supervised by Wageningen University's academics and Solynta's experienced staff. The placement will include visits (1 week - 3 months per year) to Solynta in the Netherlands to screen diploid germplasm and GWAS, do QTL mapping, data analysis and manuscript writing.

Student profile:

Students with a Plant Science, Crop Science or Food Science undergraduate degree. Candidates with analytical, molecular biology and statistical/bioinformatics skills will be a good fit to this PhD project. We encourage students with a background working in fresh produce supply chains, and an interest in sustainability.

References:

[1] Alamar et al (2017a) Assuring Potato Tuber Quality during Storage: A Future Perspective. Front. Plant Sci., 8, 2034. https://doi.org/10.3389/fpls.2017.02034

[2] Alamar et al (2017b) Minimising food waste: a call for multidisciplinary research. J. Sci. Food Ag. 98, 8-11. https://doi.org/10.1002/jsfa.8708.

[3] Tosetti et al (2021) New insights into the effects of ethylene on ABA catabolism, sweetening and dormancy in stored potato tubers. Postharvest Biol. Technol. 173, 111420. https://doi.org/10.1016/j.postharvbio.2020.111420.

[4] Sharma et al (2021) Combining conventional QTL analysis and whole-exome capture-based bulk-segregant analysis provides new genetic insights into tuber sprout elongation and dormancy release in a diploid potato population. Heredity 127, 253 – 265.

[5] Morris et al (2018) A member of the TERMINAL FLOWER 1/CENTRORADIALIS gene family controls sprout growth in potato tubers. J Exp Bot 70: 835–843. https://doi.org/10.1093/jxb/ery387.

Funding particulars:

This is a CASE project with PepsiCo International Ltd. and Solynta as industrial partners, which in combination will provide the student with placements for a minimum 4 months over the duration of the project. There is also an enhanced stipend of £2,000 pa.

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