

DEVELOPING NOVEL WATERCRESS VARIETIES FOR TASTE AND HEALTH USING MOLECULAR BREEDING IN THE UK AND USA

A three year PhD project funded by Vitacress Salads Ltd in the laboratory of Gail Taylor, registered at University of Southampton, based mostly at University of California, Davis with field work in the UK, Portugal and USA.

Project Description Developing food crops with improved taste and nutrition, alongside a reduced environmental footprint remains a significant global challenge, including developing new leafy crops for indoor vertical food production systems. In this project we will use the leafy green crop watercress [*Nasturtium officinale*] as a focus of our research where the aim is to understand the molecular genetic basis of sweetness and also the cancer-preventative chemistry for which watercress is renowned. Over ten years we have procured an extensive collection of watercress germplasm resulting in our first cultivar now registered for Plant Variety Rights - 'Boldrewood'. More recently, we have made crosses and developed a QTL mapping population, to F3, the only one available globally and have made the first molecular genetic map of watercress. We have identified a significant QTL for leaf chemistry that co-locates to anti-cancer properties using breast cell cancer lines. This will give the student a set of QTL from which to start a more detailed analysis and to add QTL to the map for novel traits. At the same time, using 10 X and minION we are sequencing the first watercress genome that should be available at the start of the project. This resource will enable the PhD to investigate the molecular genetic basis of traits, to make selections for rapid analysis including new crosses and to test new material at commercial watercress farms in the UK, USA and Portugal.

In a second approach we are developing a new globally leading germplasm collection from across the natural distribution of this species – *Nasturtium officinale* – that occurs in riparian zones around the Mediterranean basin. The PhD student will join our efforts to achieve this task. The 'wild watercress' has significant potential to reveal novel and unpredicted functional and developmental attributes. Taken together this PhD offers an exciting opportunity to engage in the latest molecular breeding technologies in a world-leading Plant Sciences department and to work with industrial partners. Three past PhD students have taken up permanent positions with Vitacress Salads following their Phd research.

Training The student will receive training in plant growth, phenotypic analysis, DNA and RNA molecular techniques, QTL analysis, making crosses, bioinformatics associated with large genomic datasets, fieldwork and working with a large fresh produce company.

Funding The project is funded by Vitacress Salads Ltd and the student will be registered at the University of Southampton, UK. At the same time, more than 50% of the student time will be spent at University of California, Davis, USA where Gail Taylor is Chair of Plant Sciences and where the mapping population is currently being grown and investigated using hydroponic vertical farming systems emerging with venture capital from Silicon Valley. All visa costs will be provided by UC Davis. The project is for three years and welcomes applicants from the UK and EU who have or expect to obtain at least an upper second class degree in Plant Sciences, Genetics, Agriculture, Biological Sciences, Natural Sciences or allied subjects. The stipend will be paid at an enhanced rate of £16,800 pa (~\$24,000). This studentship is only open to EU and UK applicants.

[1] Characterization of the watercress (*Nasturtium officinale* R. Br.; Brassicaceae) transcriptome using RNASeq and identification of candidate genes for important phytonutrient traits linked to human health. Voutsina, AC Payne, RD Hancock, GJJ Clarkson, SD Rothwell, MA Chapman, G Taylor BMC genomics 17 (1), 378. [2] Diversity in global gene expression and morphology across a watercress *Nasturtium officinale* R. Br.) germplasm collection: first steps to breeding. AC Payne, GJJ Clarkson, S Rothwell, G Taylor, Horticulture Research 2, 15029