

Younger, happier and more productive plants: using developmental genetics to improve herb yields and quality

Supervisory team:

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Host institution: University of Bristol

Project description:

If you've ever grown coriander at home, you'll have noticed that once the plant flowers it no longer produces leaves that can be used for seasoning. You may also have noticed that the leaves of the plant change slightly as they mature from juvenile to adult form. In addition to altered leaf morphology juvenile leaves are also higher in nutritionally important antioxidants. These two developmental transitions (i.e. from vegetative to reproductive growth and from juvenile to adult development), therefore, have important effects on the overall yield and nutritional quality of coriander plants. The same is true of other herb and salad crops. Delaying development of herb/salad varieties so that they remain growing in the juvenile vegetative phase, producing increased numbers of antioxidant-rich leaves, could lead to crop improvement.

An outstanding candidate for achieving this goal is the miR156/SPL genetic network. Studies of multiple plant species have shown that elevated expression of the microRNA miR156, or decreased activity of its targets in the SPL family of transcription factors, delays plant developmental transitions and leads to higher rates of leaf initiation. In this project we will investigate whether manipulation of the miR156/SPL genetic network has similar beneficial effects in two emerging crop models: coriander and salad rocket.

To confirm that developmental transitions are regulated in the same way in coriander and rocket as in other flowering plants we will first carry out detailed phenotypic and transcriptomic analyses to a) identify phase specific traits and b) reveal patterns of gene expression that are associated with juvenile vs adult development.

To test the hypothesis that suppression of SPL activity will beneficially alter plant architecture we will integrate the results of our transcriptomic analysis to identify specific SPL candidate genes to target using CRISPR-Cas9. To complement this approach, we will overexpress miR156 to reveal the effects of suppressing multiple SPL genes simultaneously. Both coriander and rocket have been successfully genetically transformed by other research groups, however, these protocols will need to be further optimised as part of the project.

As developmental transitions are regulated by environmental factors, we will also investigate the effects of different light and temperature conditions on coriander and rocket development. Finally, to test for an interaction between developmental identity and nutritional value, we will carry out biochemical assays of our new genetic lines.

In summary, this project exploits fundamental research for agricultural improvement and provides foundational training in plant developmental genetics.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.