Increasing seed yields by the targeted modulation of brassinosteroids

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Project description:
Seeds constitute the main propagule for plant growth and at the same time are the most important agricultural product, accounting for at least 70% of the world's food supply. With rising population and diminishing agricultural land, it is increasingly urgent to improve crop yields. Increasing seed size and number in seed crop species are important routes to achieving this goal, and improving food security. In situations where seeds are the most important part of the crop, e.g. oil-seed rape, wheat, maize, and rice, the best way to increase yield is to produce plants that have a higher number of seeds with no concomitant decrease in seed size or quality. In plants, such as oilseeds, where seeds are produced in pods, seed number per pod is often positively correlated with seed yield. In addition, there is also a positive correlation between oil content in seeds and seed number per pod. Brassinosteroids control a large number of agronomically important traits including seed yield, flowering time, and stress tolerance. Over-expression of brassinosteriod biosynthetic or signalling genes in Arabidopsis and rice have resulted in concomitant increases in seed yield. However, in many cases constitutive over-expression of these genes led to undesirable negative effects on plant growth and yield. This implies that changes in brassinosteroid synthesis or signalling can cause a combination of positive and negative effects on traits that are of interest. Therefore, the use of tissue specific promoters represents a strategy for increasing crop yield by modulating the level of brassinosteroids and harnessing their role in plant development.

The project will focus on introducing selected brassinosteroid-related genes into Arabidopsis under the control of distinct tissue-specific promoters and investigating the subsequent effects on seed yield traits. Specifically, we will identify genes that increase the number of ovules in a plant leading to an increased number of seed per pod. We will then test the ability of these introduced genes to increase seed yield overall.

The project will use a combination of molecular, developmental, and cell biological techniques and provide training in the disciplines of plant genetics, genomics as well as bioinformatic, statistical, and microscopy techniques.

Arabidopsis siliques from a control plant (WT) and a line over-expressing a seed number regulator (TD4). The over-expressing line exhibits longer pods (image on the left) and more seeds per pod (image on the right).