Produce quality of cultivated plants is inherently determined by metabolites, whether it is nutritional value, colour, shelf life or flavour of plant products. At the same time, many biological interesting traits, such as yield, flower set, stress tolerance, seed quality, pesticide mode-of-action or disease resistance are influenced or regulated by metabolites. Metabolomics can help to understand the underlying mechanisms of plant characteristics. In plant research it acts as a tool to understand and explain gene function, as well as physiological functions. In plant breeding, metabolite profiling is able to support the trait discovery process. Besides that, the identification of early selection biomarkers can speed up the breeding process significantly.

Read about the case study Nutrient and Flavour Identification in Tomato on the back.
Most modern cultivated crops have only very limited genetic variation available compared to their ancestors, the related wild species. In order to improve specific traits in modern varieties, like taste or disease resistance, these wild species are more and more commonly used as genetic resources in crop breeding. In this case study, metabolite profiling was applied to the identification of metabolite traits in a set of tomato breeding lines crossed with a wild tomato. This resulted in the identification of over 880 genetic regions for a metabolite trait (QTL) that were stable over two independent harvests. Many of these metabolites display nutritional, agronomical or organoleptic importance. Metabolite profiling revealed a genetic region responsible for increasing several metabolites, which were closely linked and thus belong to one biochemical pathway. One finding was that sugar levels of fructose and glucose are generally very closely linked and only a few QTL express different levels of glucose fructose ratios. A genetic region in tomato could increase taste levels by at least two fold due to increases in sugar content, organic acids and umami metabolites (Figure 2).

![Figure 1: Heatmap of metabolic changes in tomato lines](image1)

![Figure 2: Upregulation of taste metabolites at a specific genetic region](image2)