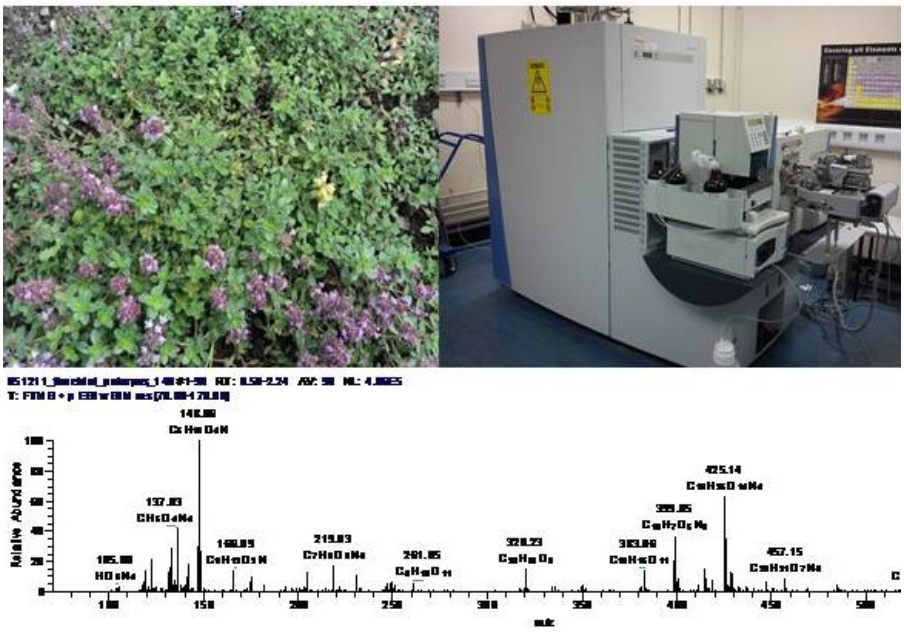
USE OF METABOLOMICS TO STUDY WATER DEFICIT STRESS ON THE MEDICINAL PLANT THYME



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ABSTRACT

Thyme is one of the best known genera within *Labiatae* (or *Lamiaceae)* family, because of it consists of more than 200 species and has diverse medicinal and culinary uses. Environmental factors such as drought can affect plant growth and production of secondary products. Understanding plant response to drought is of great importance and can facilitate the development of drought tolerant varieties. In the present thesis a range of genotypes of thyme was examined including *Thymus vulgaris*, *T. serpyllum, T. daenensis, T. kotchyanous, T. capitata and T. zygis* selected for differences in both drought tolerance and essential oil composition. Drought stress was imposed on 30 day old plants and traits such as leaf water potential, water content, root/shoot weight ratio and survivability were measured. Together these traits indicated that *T. serpyllum* was the most tolerant and *T. vulgaris* the most susceptible populations. A time-course of metabolite profiling using direct infusion FT-ICR mass spectrometry identified the most significantly changing metabolites in *T. vulgaris*. A comparison of metabolite finger print indentified differences in both polar and non-polar fractions. Metabolites including amino acids, carbohydrates, organic acids and lipids changed significantly during long-term water deficit. These results suggested that mechanisms adapting thyme to drought may include osmotic adjustment, ROS scavenging, cellular components protection, membrane lipid changes and hormone activity in which the key metabolites were proline, betaine, mannitol, sorbitol, ascorbate, JA, SA, ABA precursor, unsaturated fatty acids and tocopherol. Profiling of volatiles using GC/MS, showed an increasing -decreasing trend at major terpenes apart from thymol, alpha-cubebene and germacrene in sensitive plants. By contrast, tolerant populations had unchanged terpenes during the water stress period with an elevation on the last day. These results suggests that tolerant and susceptible populations of thyme employing different strategies in response to drought. In conclusion, the combination of metabolite profiling and physiological parameters contributed to a greater understanding of the mechanisms of thyme plant response at metabolomics level.

Keyword: Metabolomics, medicinal plant, thyme, water deficit, stress