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Modifications of leaf lipid composition in the responses of thyme plant to drought stress

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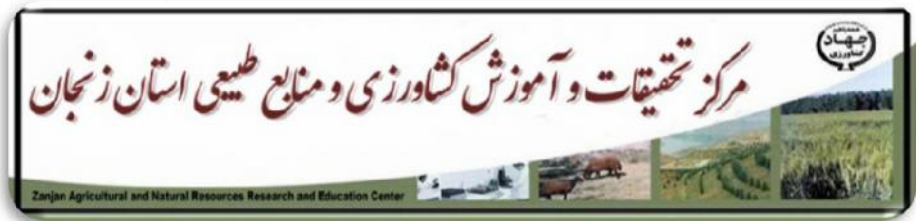
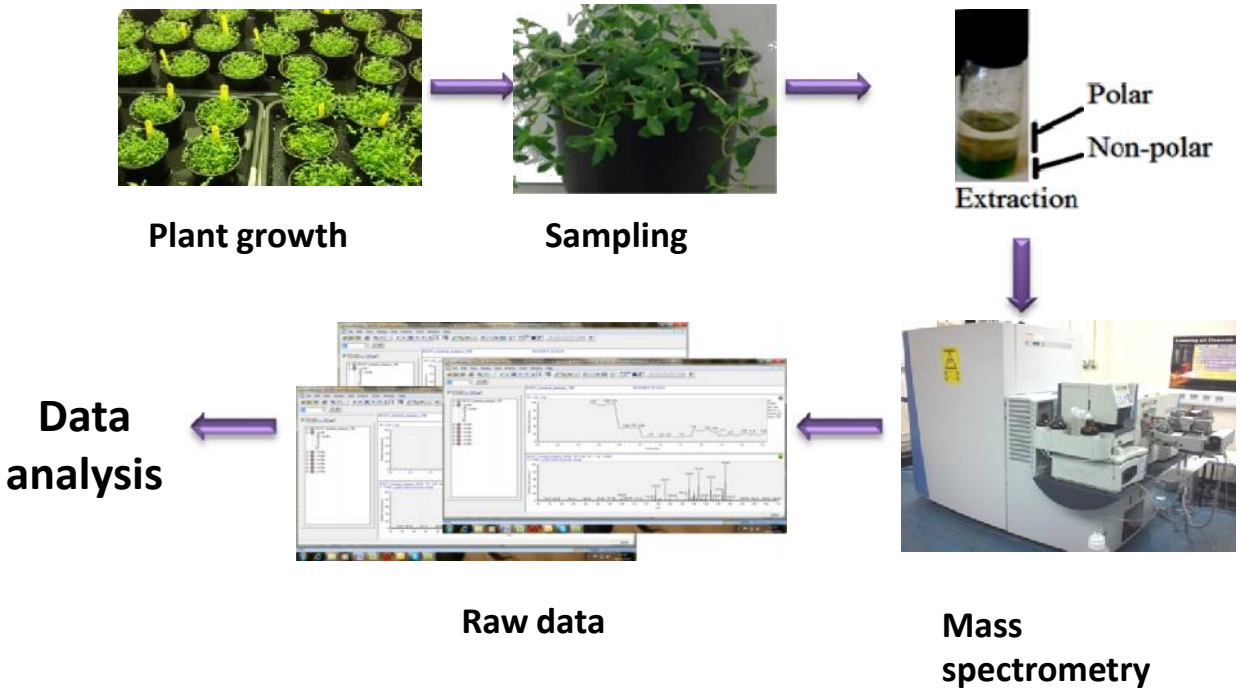


Modifications of leaf lipid composition in the responses of thyme plant to drought stress

Graphical Abstract



Abstract: One slide, Max 200 words

Plants are often exposed to environmental stresses such as biotic and abiotic stresses, which imposed by salt, drought, high/low temperature, heavy metals, nutritional deficiencies as well as pathogen and insect attacks. Lipids are one of the most crucial cellular components because they provide not only the structure of cell membranes, but also energy storage for cell metabolism. In recent years evidences have proven that lipids possess two major roles in response to stress. First, as a signalling mediator, second their role in the process of alleviating the deleterious effects of stress. The effect of prolonged water deficit stress on lipid composition was studied on tolerant and sensitive thyme plants (T. serpyllum and T. vulgaris respectively). Non-targeted non-polar metabolite profiling were carried out using FT-ICR mass spectrometry along with morpho-physiological parameters performed on one month old plants subsequent to water withholding before the plants wilted. Different trends for a number of non-polar metabolites were observed when comparing stressed and control conditions for both sensitive and tolerant plants. Declining the amount of total lipids was observed in droughted plants. This trend is more pronounced for the main lipid components such as galactolipids (MGDG, DGDG) in addition to phospholipids (PG, PE, PA and PS) which decreased to 55%. Among the MGDG class of lipids, 790.5221 m/z was the most affected lipid which decreased of about 70% in stressed plants. In tolerant plants, among detected phospholipids, including PI, PS, and PC, metabolites having m/z values 519.3331, 521.3488 and 581.3709 decreased about 50-60% whereas they having m/z values 845.5516, 840.5053, and 840.5053 were the most affected phospholipids which increased over 200% in response to drought stress. In conclusion, Tolerant and sensitive plants had clearly different response at physiological and metabolic level.

Keywords: Mass spectrometry; Metabolomics; abiotic; stress; lipid

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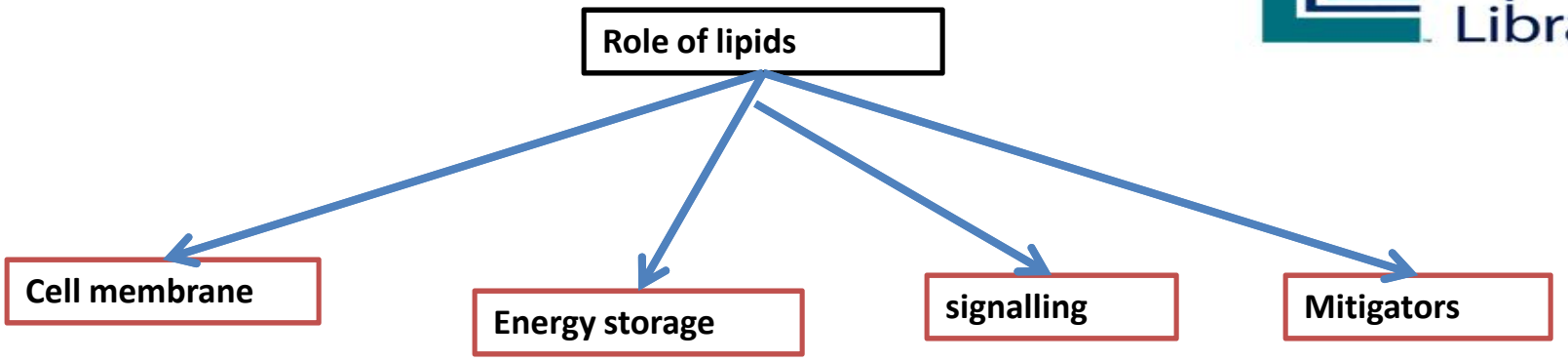
Introduction

The LipidHome

LIPID MAPS

LipidBank

AOCS Lipid Library



DGDG, MGDG
SQDG, PG, PC, PE, PI, PS,
GLPCm, GlcCer

Mainly triglycerides in seeds

PA, PLs, SLs, Lyso-PLs, Oxylipins, N-acylethanolamines, FFAs

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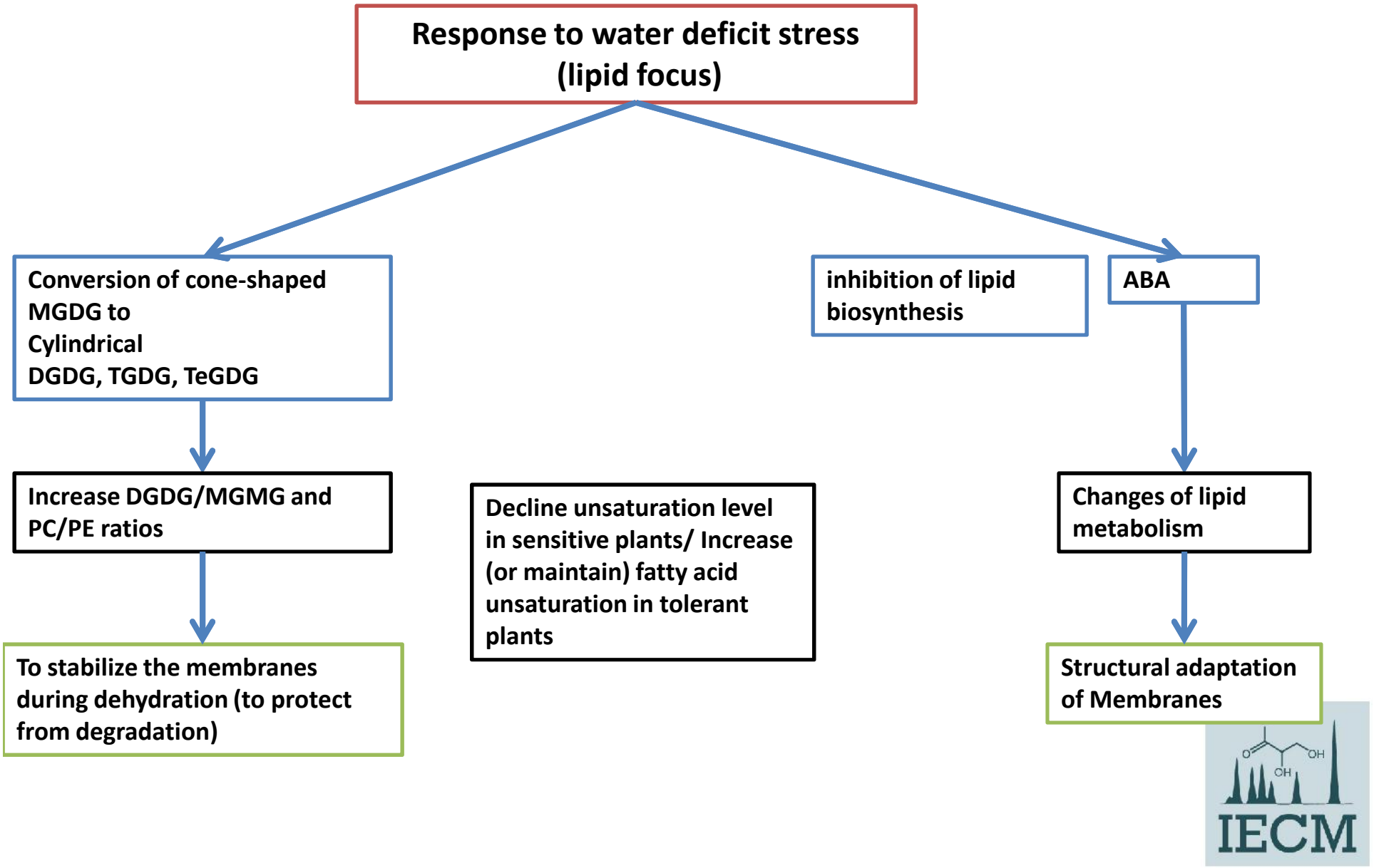
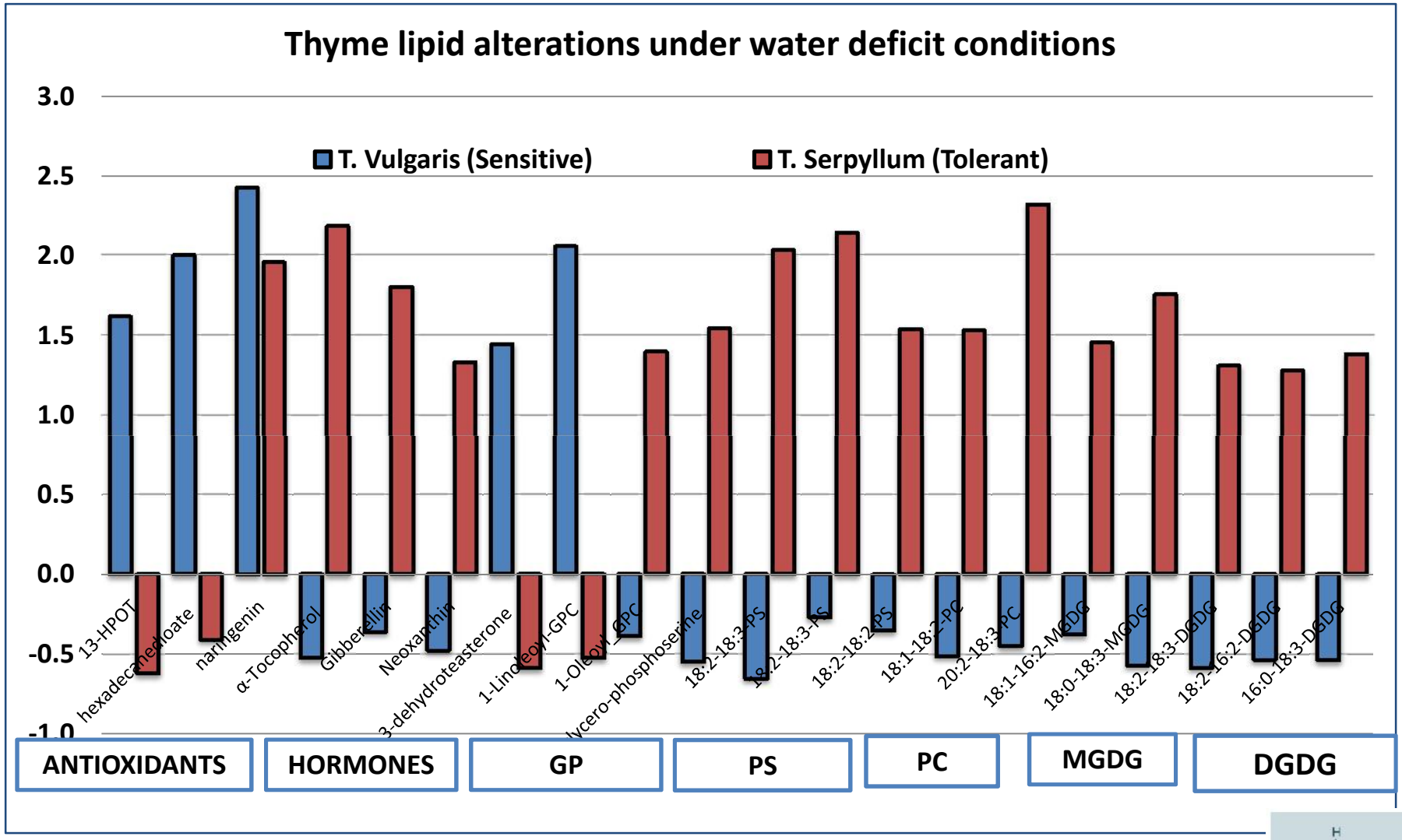
Results and discussion




Thyme lipid alterations under water deficit conditions
T. Vulgaris (Sensitive)
T. Serpyllum (Tolerant)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
13-HPOT
hexadecanedioate
naringenin
α-Tocopherol
Gibberellin
Neoxanthin
3-dehydroteasterone
1-Linoleoyl-GPC
1-Oleoyl-GPC
lycero-phosphoserine
18:2-18:3-PS
18:2-18:3-PS
18:2-18:2-PS
18:1-18:2-PC
20:2-18:3-PC
18:1-16:2-MGDG
18:0-18:3-MGDG
18:2-18:3-DGDG
18:2-16:2-DGDG
16:0-18:3-DGDG
ANTIOXIDANTS
HORMONES
GP
PS
PC
MGDG
DGDG

Conclusions

- Experimental data indicated outstanding decline of lipid amount in sensitive plants
- In contrast, total lipid content elevated in tolerant plants
- Phosphatidylcholine (PC) and digalactosyldiacylglycerol (DGDG) contribute in the stability of membrane and consequently protect membrane from degradation
- Lipidomics can be used as early testing tool to screen the thyme population for drought tolerance
- Alteration in membrane lipid composition correlate to drought stress intensity and tolerance and sensitivity of plant

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Acknowledgments

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