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Chemistry at the service of Plant Science to decipher Plant Metabolism

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1. Plateforme Bordeaux Metabolome
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3. ASTREDHOR Sud-Ouest

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Chemistry at the service of Plant Science to decipher Plant Metabolism

Background

The performance of crop plants (yield and fruit quality) could be predicted through mathematical modelling of chemical data, highlighting molecular, metabolic, cellular and physiological mechanisms¹. Biostimulants are innovative solutions recommended in Agriculture to boost plant growth in condition of abiotic stress, but the mechanisms remains still poorly known.

Objectives

Our research work is conducted in order to study the plant stimulation with biostimulant solution to tackle environmental stresses and investigate underlying physiological and metabolic trade-offs in tomato.

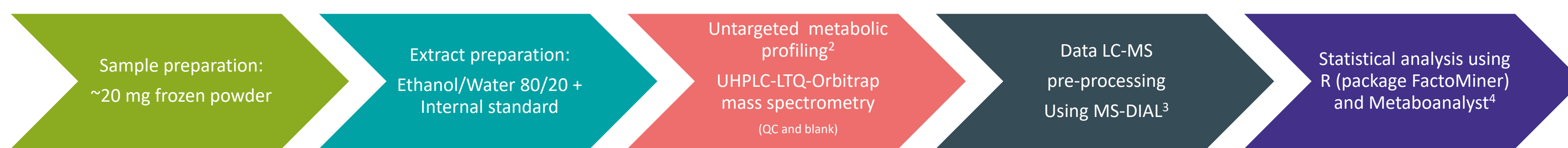


Methodology

Culture conditions: M1 (negative control with water application), M2 (Stim Pure Liquid Van Ippen International - Spray 0.2% at repotting, watering 6 days later then every 10 days), M3 (Stim Pure Liquid - Root ball soaking for 5 minutes at 0.2% before repotting (~23 mL/plant), then foliar spraying during flowering)

Sampling : n=68 pericarp of tomato fruits; One fruit harvested/Plant, 30 plants/Condition (10 plants/experimental unit; 3 blocks/Condition; sowing week 16; repotting week 22).

Dataset : 68 observations of pericarp and 4266 variables (metabolic features)



Results & Discussion

- ✓ PLS-DA: Two clusters were separated, control versus biostimulant application, with 58% of the covariance explained by the first two dimensions (fig 1).
- ✓ Highlighting the importance of the biostimulant application mode: More homogeneous fruit metabolic profiling in response to biostimulant application at the time of repotting (M3/fig. 2).
- ✓ Separation of M1/M3 groups by biochemical markers with low values (in blue) and high values (in red), like X2383 (Fig. 3).
- ✓ Annotation of features: For example, X2383 annotated as 3,4-dihydroxy-2-methylidenebutanoate (InChIKey-OAVZGKBBHXFFGL-UHFFFAOYSA-N).
- ✓ X2383 known to cause irreversible acylation reaction and histone acetylation in the plant cell plays an important role in plant growth⁵.

Conclusion & Perspective

This strategy at the interface of chemistry and biology, is promising to identify biochemical markers and decipher mode of action of biostimulant and the performance trade-offs for the crop species. The next step is now to annotate the unknown markers and to link these chemical data with phenotypic and meta- data (climate...) captured and managed with two tools (LINDA and ODAM).

References

1. Luna, E. et al. (2020) Metabolomics to Exploit the Primed Immune System of Tomato Fruit. *Metabolites* (doi.org/10.3390/metabo10030096)
2. Tsugawa H et al (2015) MS-DIAL: data-independent MS/MS deconvolution for comprehensive metabolome analysis. *Nat Methods*. (PMID: 25938372)
3. Decros G. et al. (2023) Enzyme-based kinetic modelling of ASC-GSH cycle during tomato fruit development reveals the importance of reducing power and ROS availability. *New Phytologist* (doi.org/10.1111/nph.19160)
4. R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.

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Bordeaux Plant Sciences

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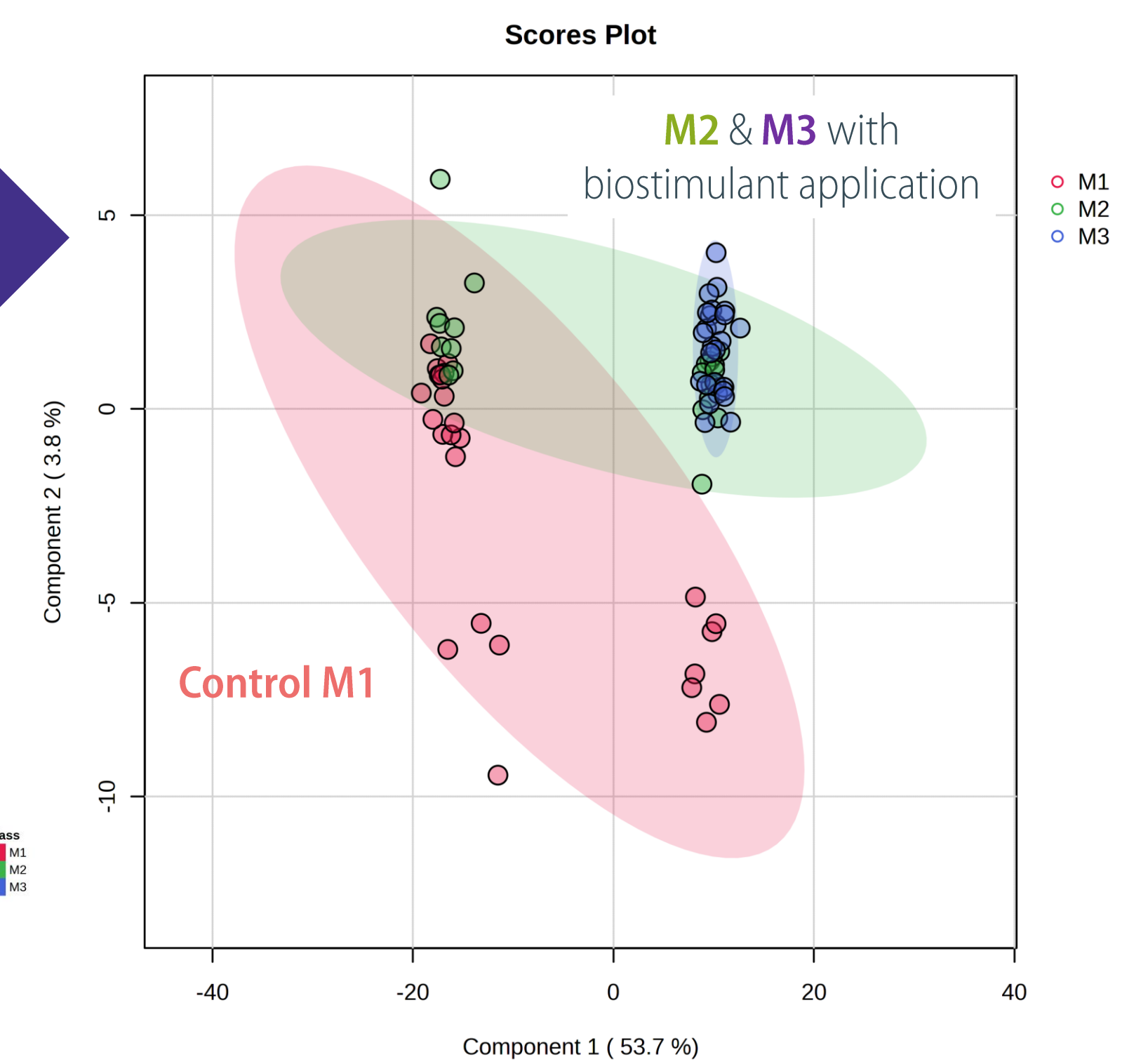


Fig 1: PLS-DA

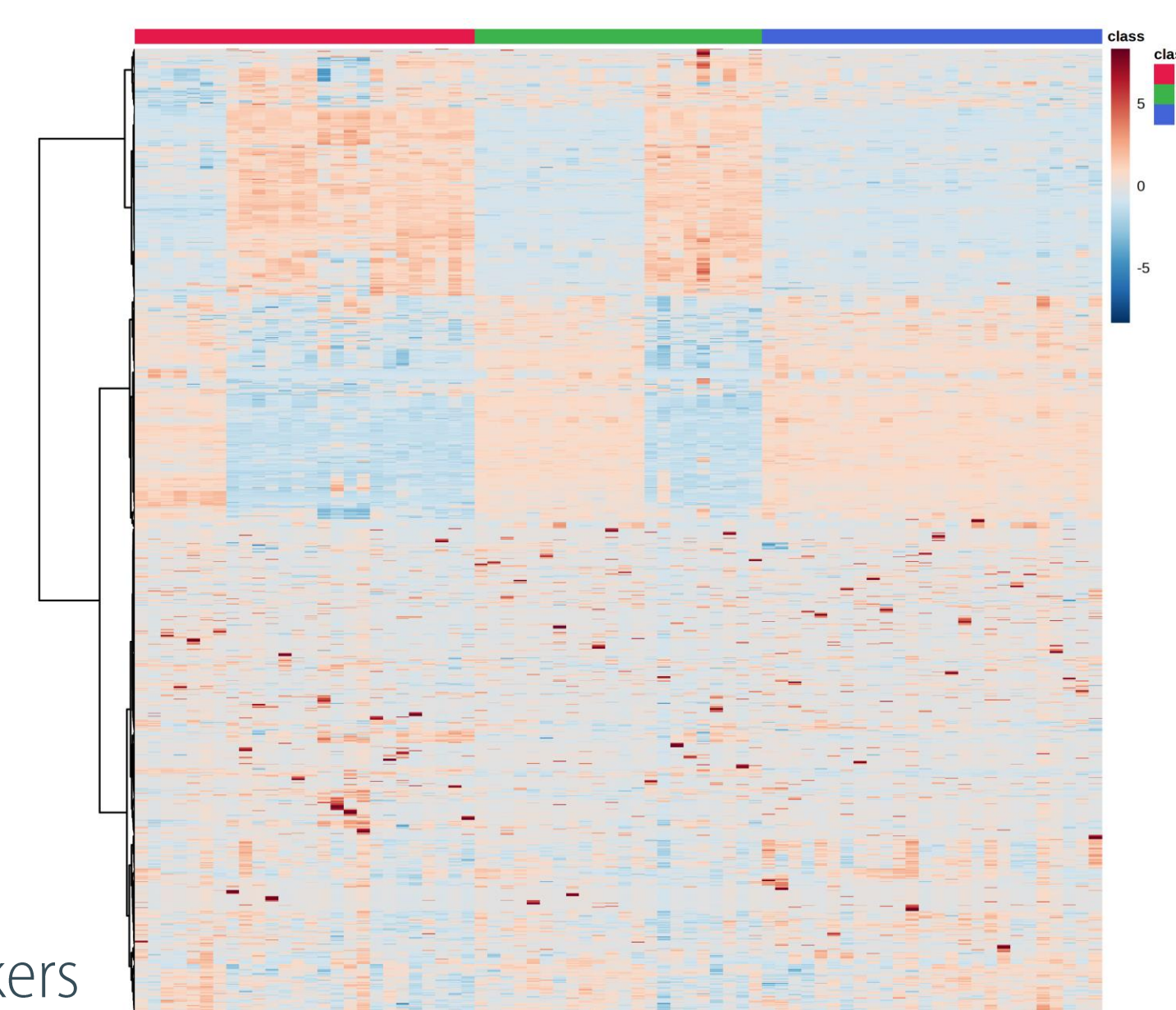


Fig 2 : Heat map

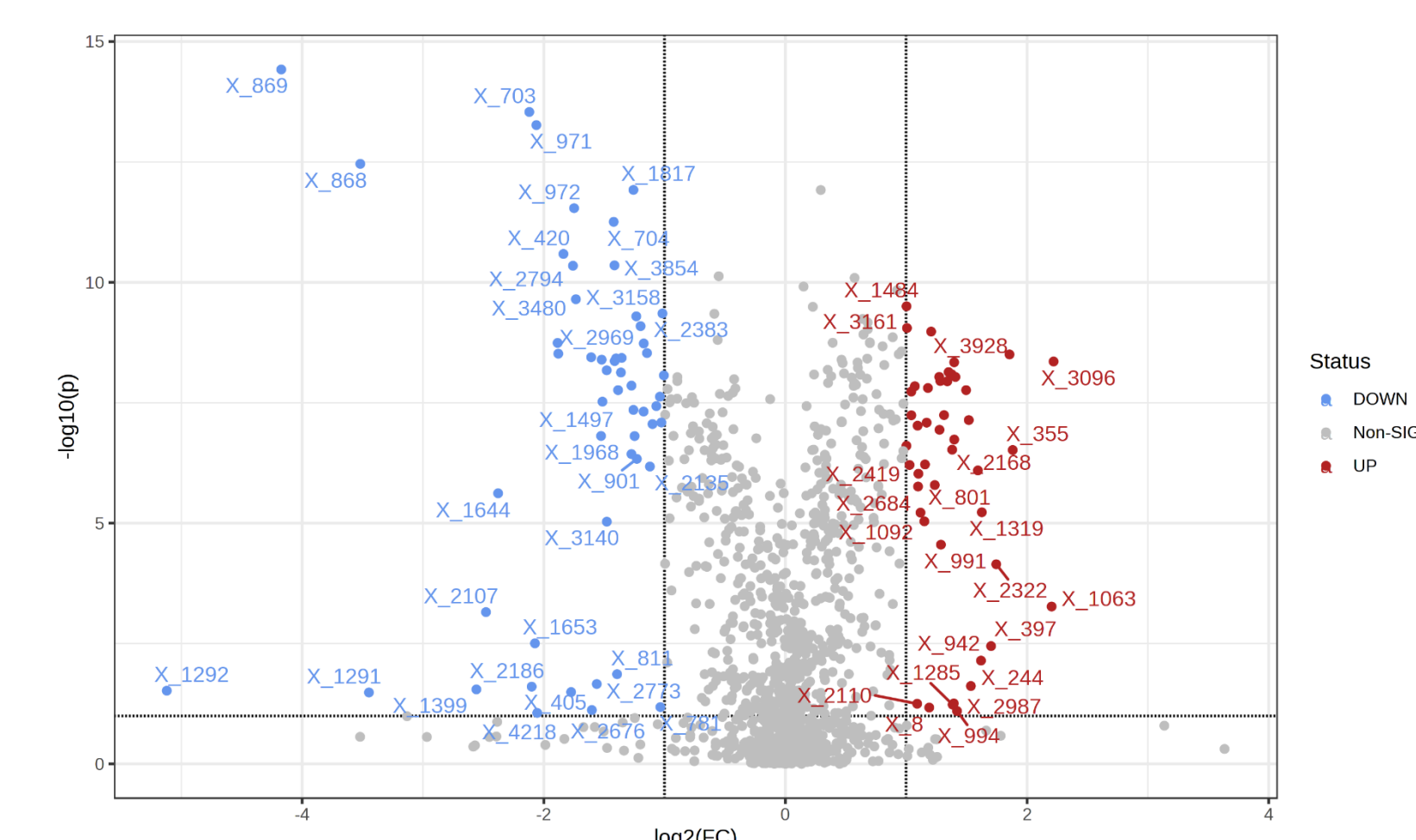


Fig 3 : Volcano plot M1/M3