

Abiotic stress tolerance: exploring natural diversity among Cabo Verde *Diplotaxis* species

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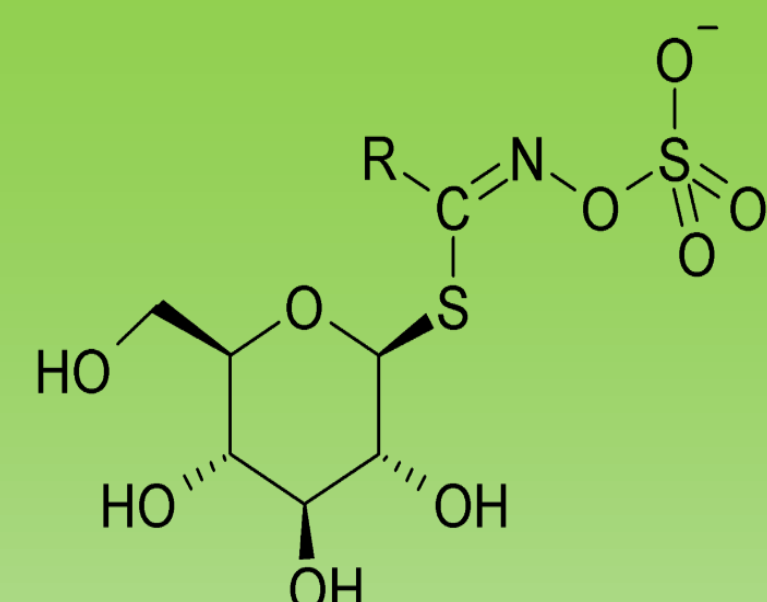
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ABSTRACT

Brassicaceae family, which includes well-known crops such as kale, cabbage, broccoli, Brussels sprouts, and cauliflower, are known for their characteristic and high content of secondary metabolites, such as glucosinolates (GLS). GLS (indolic and aliphatic) are compounds known for its beneficial health properties and its involvement in abiotic stress tolerance, such as salinity and drought. However, a complete overview between genes to metabolite is still lacking to uncover potential mechanisms of inherent abiotic tolerance in Brassicaceae, but also between *Brassica* crops and its closest taxa. Our work aimed to perform a comprehensive assessment of the GLS biosynthetic pathways in Brassicaceae family coupled with the analysis of chemical GLS profiles, focused in *Diplotaxis* sp, which are wild relatives of economically important *Brassica* crops, with a possible correlation between GLS chemoprofiles and abiotic stress resilience. Our results show a recent diversification of the aliphatic CYP79F1 and F2 genes in Brassica crops while for indolic genes an earliest diversification is observed for CYP81F1–F4 genes. Our results showed a common diversification of indolic GLS genes that portrays Brassica crops chemotypes, which are present in less extent in aliphatic GLS. Regarding GLS chemoprofiles analyses the aliphatic glucoerucin involved in salt tolerance raised as a distinctive chemical signature of the *Diplotaxis-Eruca* lineage, separating from the Brassica crops chemo-lineage. Thus, neglected rocket species seem to display a different GLS profile that could be associated to higher abiotic stress tolerance. As such, wild *Diplotaxis* taxa from Cabo Verde, which are adapted to extreme ecological conditions (i.e. severe salinity and drought conditions), may be considered potential targets to understand abiotic stress tolerance mechanisms for future crop improvement in Brassica crops.

INTRODUCTION

GLUCOSINOLATES



Aliphatic

- Alanine
- Leucine
- isoleucine
- valine
- methionine

- bitter taste, pungency and astringency
- Secondary metabolites found in Brassicaceae family;
- Glucosinolates and their breakdown products are been proven to
- have anticarcinogenic and chemopreventive effect;

Aromatic

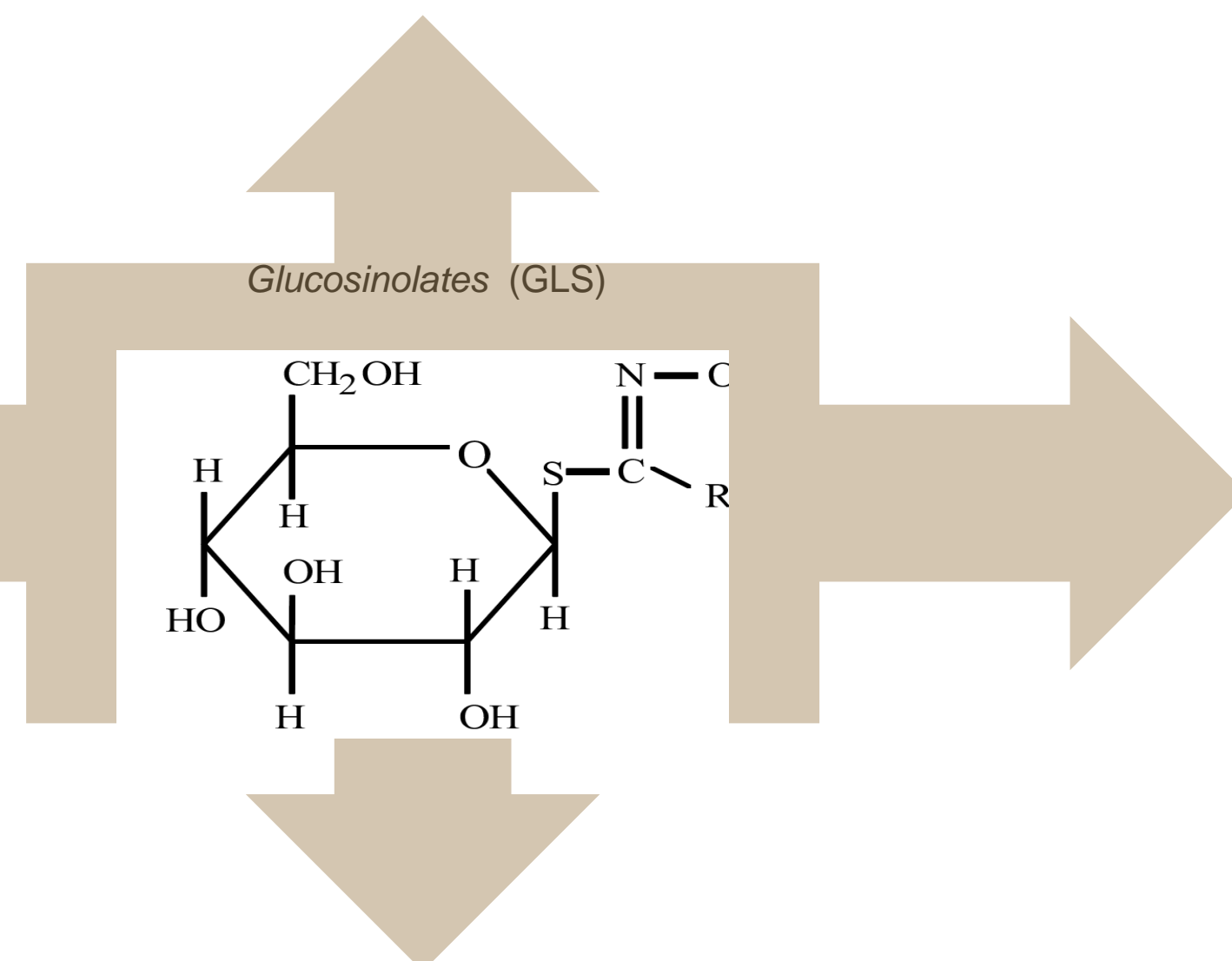
- tryptophan

Indolic

- phenylalanine
- tyrosine

Are GLS related with abiotic stress tolerance?

Which genes are involved in GLS biosynthesis?



Can chemo-profile differences be depicted between Brassicaceae taxa?

Can GLS pathways diversification be observed?

RESULTS

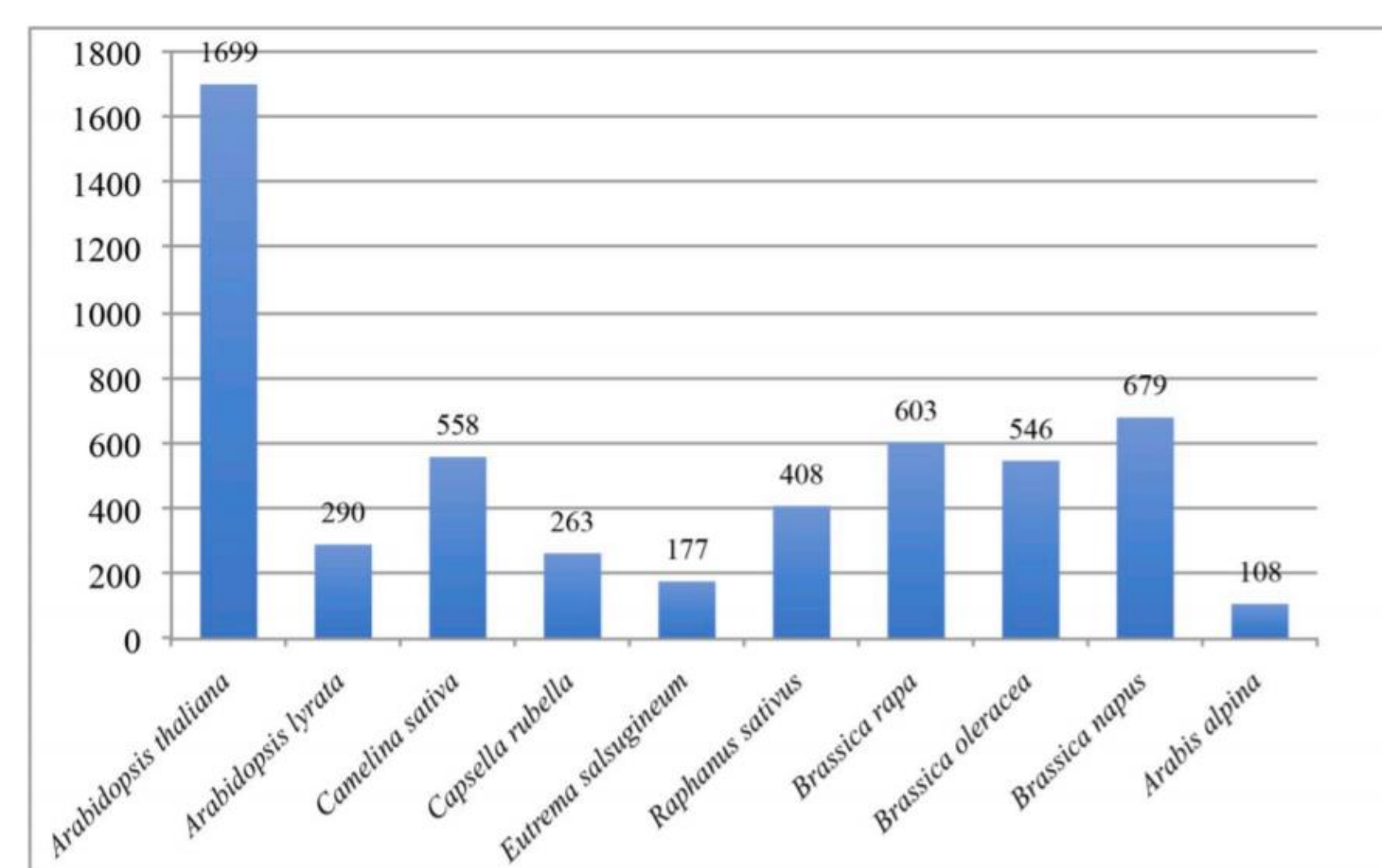


Fig. 1 - Genomic information of the GLS biosynthetic genes of the top ten Brassicaceae species registered at NCBI database.

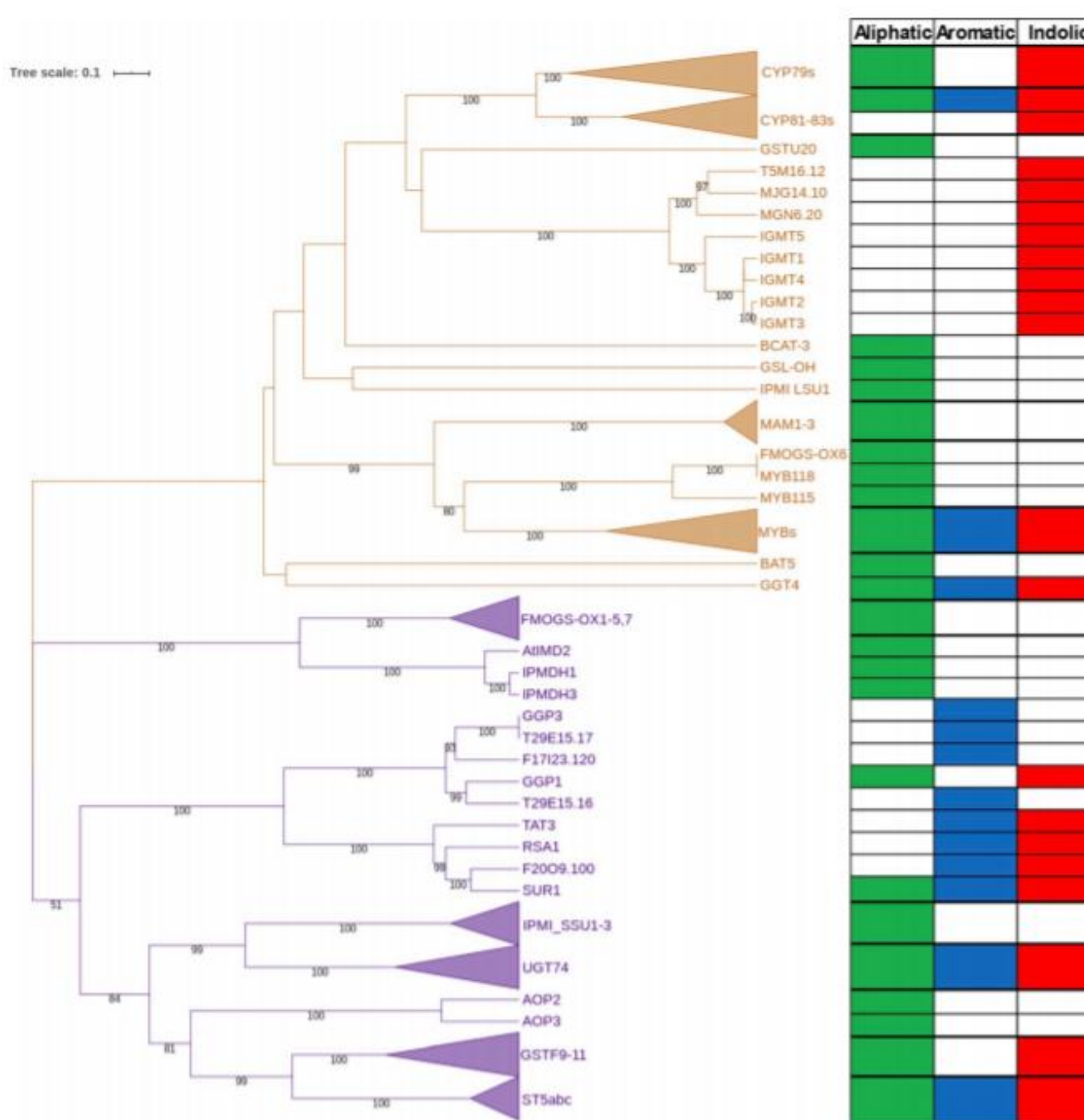


Fig. 3. UPGMA phenogram of the 101 GLS biosynthetic genes. Bootstrap values above 50 are represented on the branches.

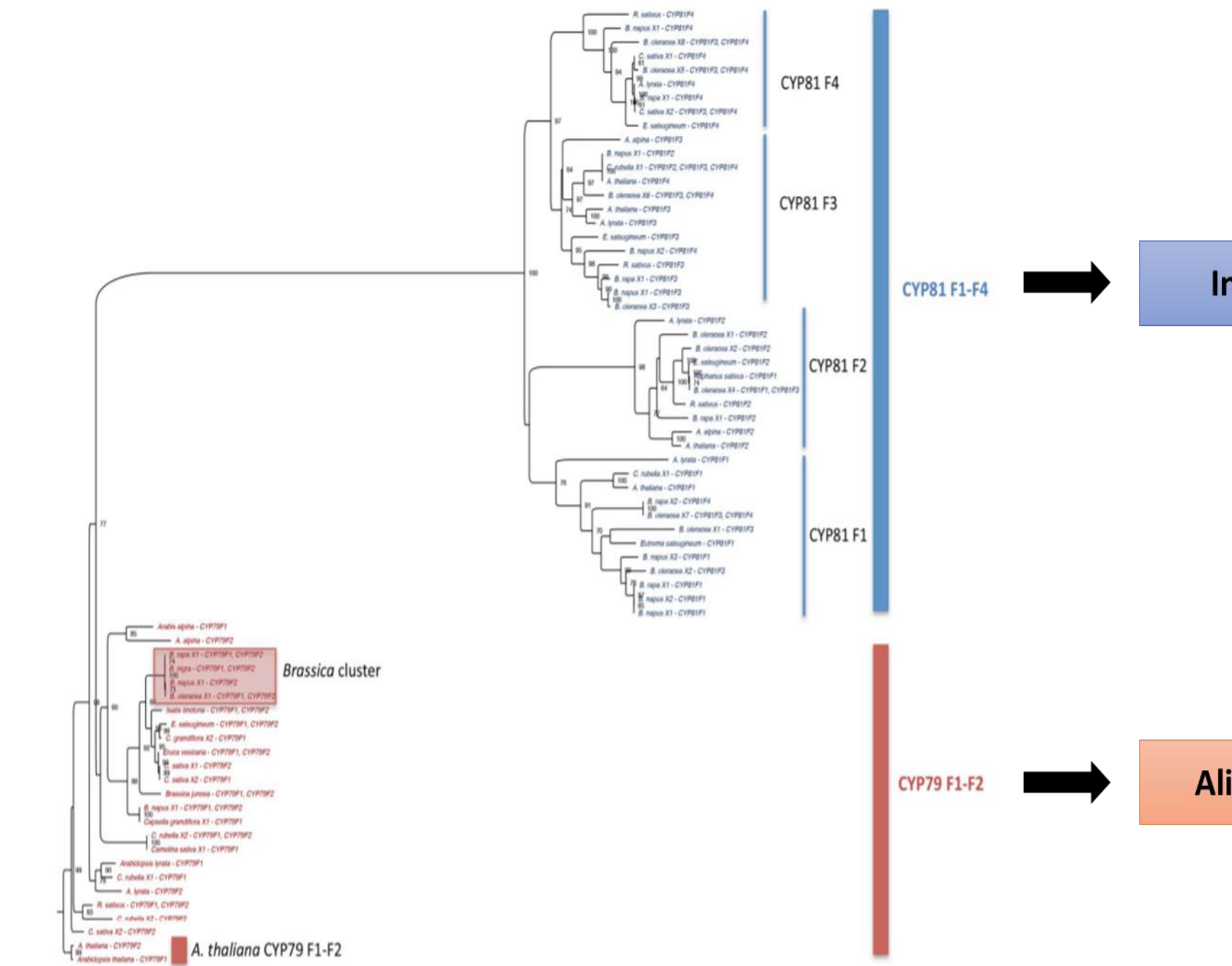


Fig. 5. Phylogenetic tree from the Maximum Likelihood analysis of CYP79F1–F2 and CYP81F1–F4 genes in Brassicaceae with *A. thaliana* CYP79F genes as outgroups.



Fig. 2. Euler diagram displaying GLS gene annotation gathered from a multi-database approach.

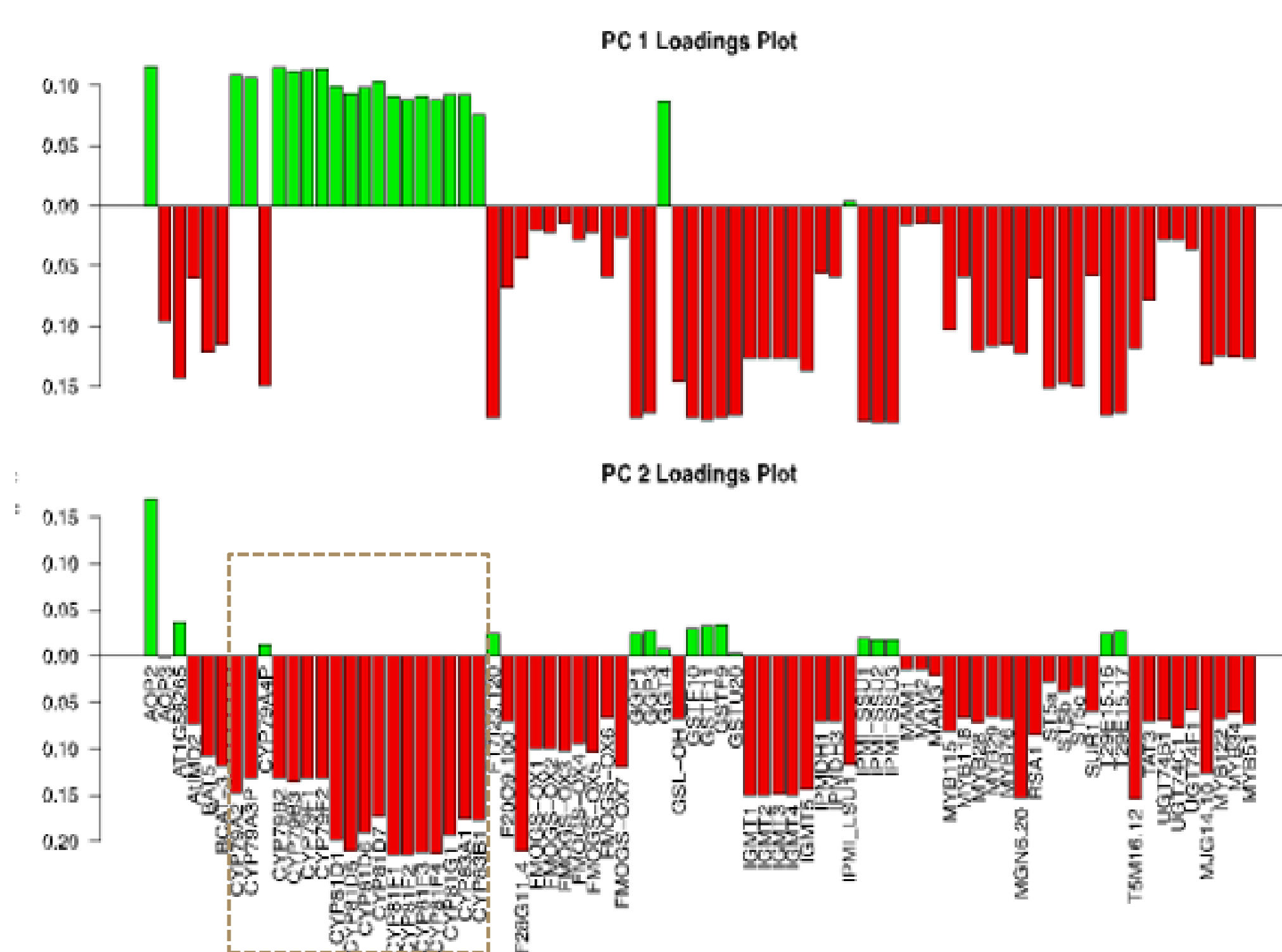


Fig. 4. Principal Component Analysis (PCA) to assess gene grouping discrimination associated to each sub-pathway.

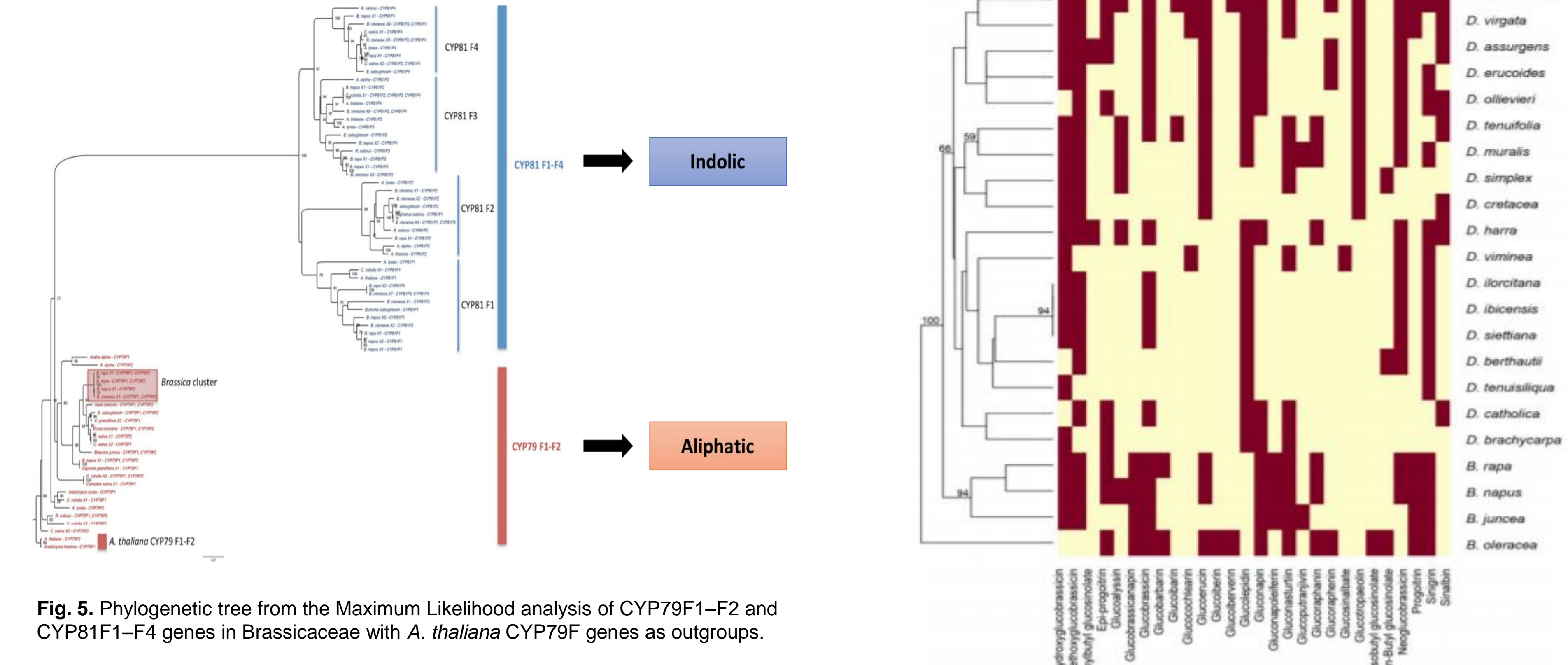


Fig. 6. Chemodiversity profiling of GLS in Brassica and rocket species (*Diplotaxis* and *Eruca*).

CONCLUSION

- UPGMA and PCA separation between genes in GLS core structure and CYP450/MYB gene families.
- Phylogenetics revealed a recent diversification of aliphatic genes and an earliest for indolic.
- Distinct GLS chemo-profiles between Brassica crops and Diplotaxis species, wild relatives.
- GLS-rich species as a new source of taxa with great agronomic potential for abiotic stress tolerance.

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