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Leaf specialized metabolome of *Quercus pubescens* exposed to amplified drought

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Context of the study

The intensification of summer drought expected with climate change in the Mediterranean region can induce metabolism modifications in plants to help them cope with such conditions. In the long term, these modification may impact diversity and global ecosystem functioning.

Material and Methods

- an *in situ* experimental site, equipped with a rainfall exclusion device, allowed reduction of natural rainfall by 30% over the tree canopy.
- leaves of ND and AD plots were collected in spring, summer and fall during 3 years (2nd, 3rd and 4th years of drought application).
- a **targeted approach** was used to focus on phenolic metabolites.
- an **untargeted approach** permitted to study a broader metabolome variation according to drought.

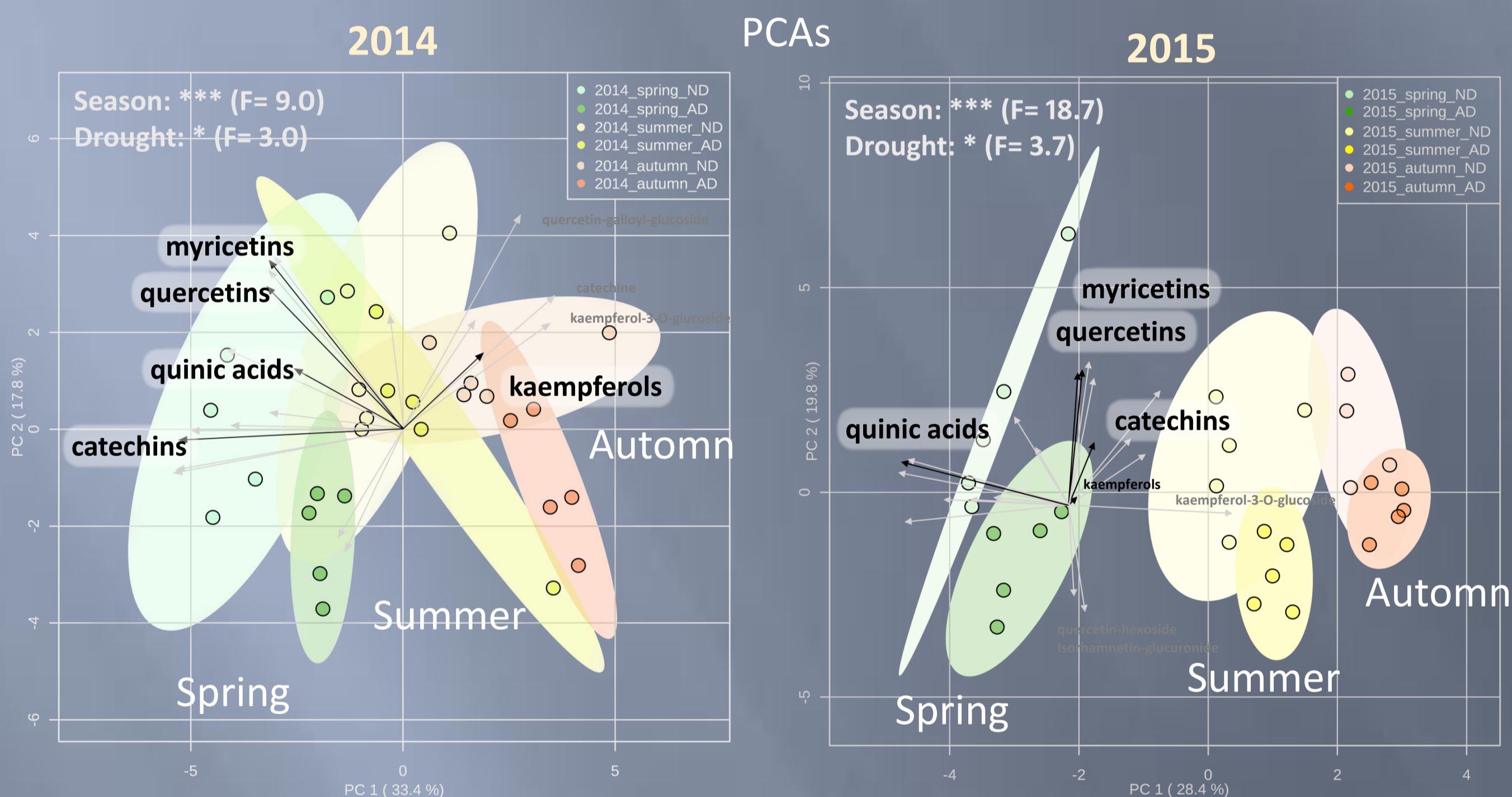


Drought were particularly strong in 2015 compared to the annual mean of cumulated precipitations calculated on the period 1967-2000 (dash lines).

In consequence, ND endured by oaks in 2015 was higher than AD in 2014.

Results

Targeted approach: a drought effect was observed for both years ($p < 0.05$), while the metabolomic profiles were mainly influenced by phenology ($p < 0.001$, two-ways permanova).

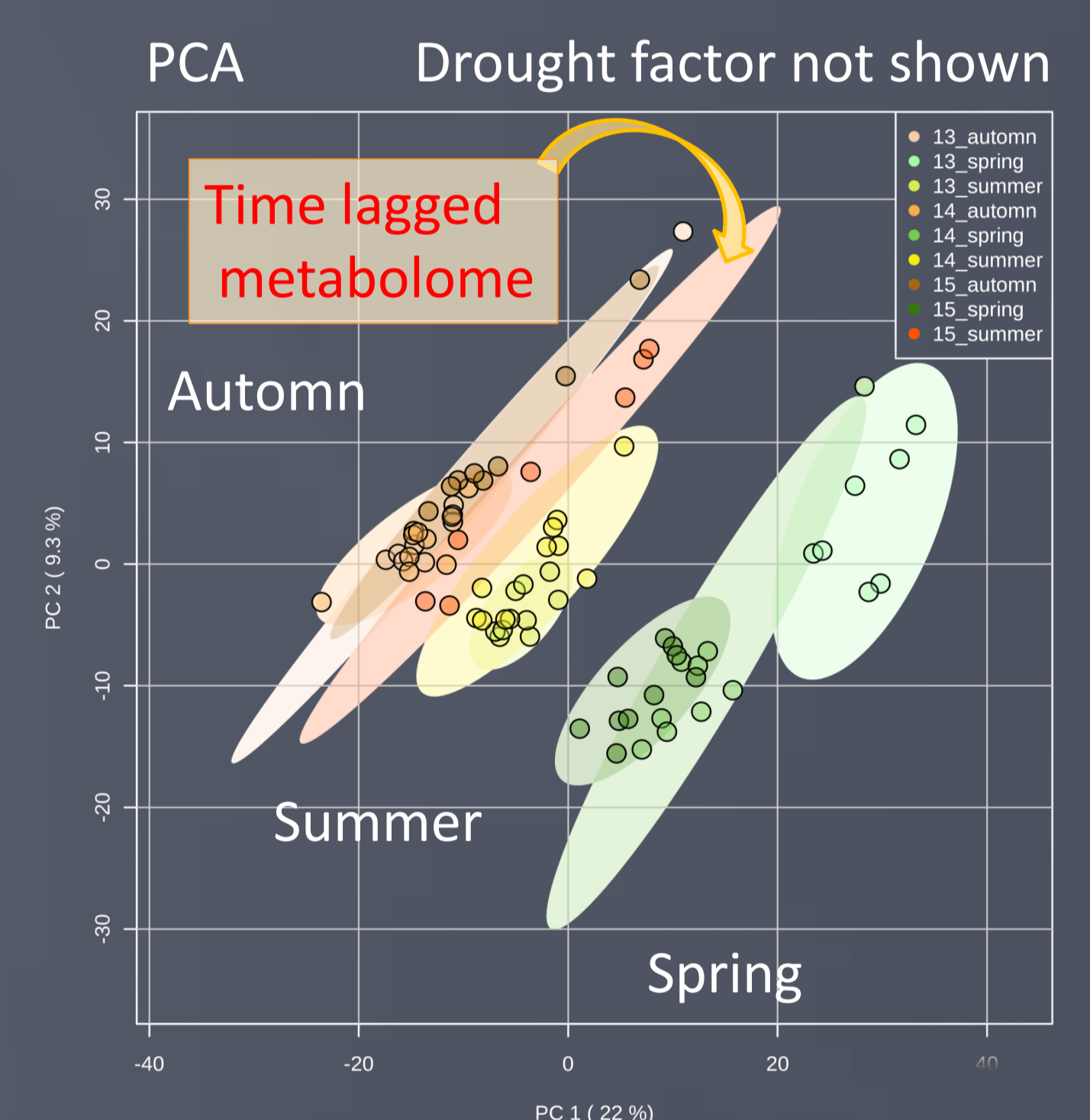


Untargeted approach: The effect of drought on *Quercus* metabolome was weak (ns in 2013 ; $p < 0.05$ for 2014 and 2015) whereas metabolome is mainly driven by seasons ($p < 0.001$ for all years, two-ways permanova).

In 2015, the particular dry year, we observed that the global metabolome of ND and AD leaves sampled in summer presented an early "autumnal" pattern, suggesting a seasonal time lag of the chemical content.

Seven metabolites were highlighted as drought biomarkers using an univariate analysis (Venn diagrams). These biomarkers, still under study, likely belong to the phenylpropanoid pathway with one corresponding to kaempferol pentoside.

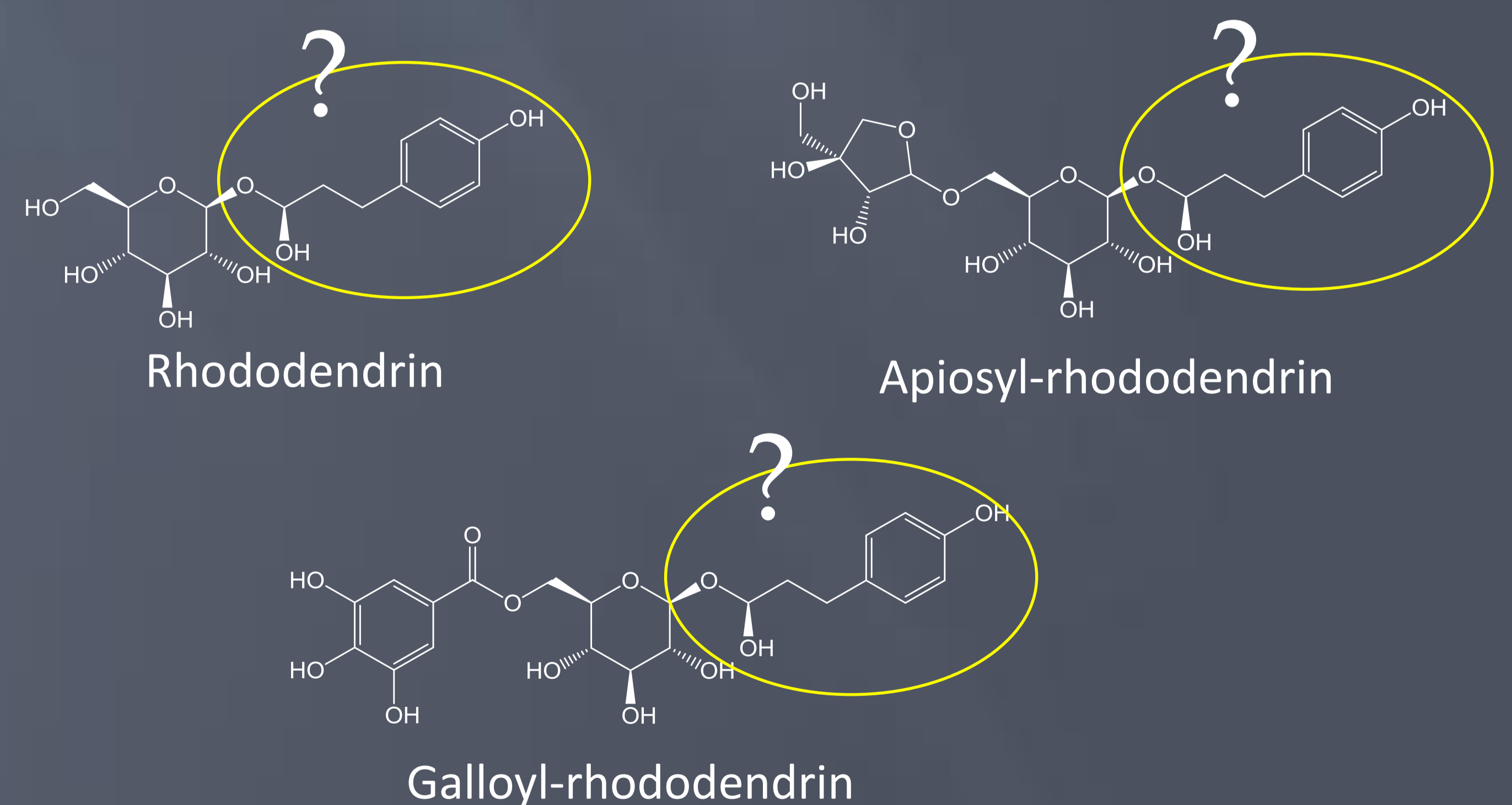
Three of them might be linked to rhododendrin (with apiosyl rhododendrin and galloyl rhododendrin / waiting for co-injection of standard to be confirmed).



We observed:

- a decrease of global myricetins and quercetins concentrations with drought application at each season.
- an increase of kaempferols concentrations in summer.

The harsher conditions of 2015 stressed the effects of season on oak metabol (wic profiles ($F= 9.0$ in 2014, $F=18.7$ in 2015)). Kaempferol-3-O-glucoside, specific to autumn, was enhanced in summer 2015, whatever drought treatment.



Conclusions

Targeted and untargeted approaches permitted to demonstrate a time lag of the phenylpropanoid pathway over leaf phenology when trees were exposed to drought. Quercetins, catechins and myricetins, specific to summer leaves were down-regulated to favor the biosynthesis of kaempferols, specific to autumnal leaves. Further studies would be necessary to understand how this time lag phenology may impact ecosystem functioning.

Acknowledgments

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