# Understanding fungal communities of olive tree leaves for application to climate change adaptation 

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## Abstract

The olive tree (Olea europaea subsp. europaea L.) is a typical plant of the Mediterranean vegetation, well adapted to drought and poor soils being also tolerant to high solar irradiance. The phyllosphere microbiota associated with these plants is likely to play a role in their tolerance to such harsh environmental conditions. Here, we have characterized the endophytic and epiphytic fungal community present in leaves of olive trees, for potential application of these insights to climate change adaptation. Leave samples were collected from a rainfed olive orchard near Mirandela (NE Portugal). Fungi were isolated and counted from the surface and inner tissues of leaves. The isolates obtained were identified by ITS rRNA gene sequencing and their phylogenetic diversity was then analyzed. A Celerioriella-like species and two unassigned species belonging to Phaeomoniellaceae and Pleosporineae were the most abundant taxa within 23 species (out of 161) found in both epiphytic and endophytic subsamples. These strains are good candidates to be studied for their resilience to climate changes in order to be applied as "tolerance inducers" in olive crops from this Mediterranean area.

Keywords: Fungal diversity; endophytes; epiphytes; Internal transcribed spacer; phylogeny

## Results and Discussion

- Higher species richness in epiphytes (99 spp.)
- Higher species evenness in endophytes
- Several endophytes fungi unassigned


Mycospharellaceae 10\% Pseudocercospord aff. cladosporioides (4.8\%) *

The five most abundant taxa * represented:

- $63,9 \%$ of epiphytes
- $33,3 \%$ of endophytes

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2020

## Results and Discussion：phylogeny of Dothideomycetes

70 Cladosporium aff．tenuissimum CIMO 19DM241

Endo
MH682175 Cladosporium sp．AWCR－2018a strain COAD 2135
MH864840 Cladosporium tenuissimum CBS 125995 Cladosporium crousii CIMO 19DM282 MH865096 Cladosporium phaenocomae CBS 128769 Cladosporium subcinereum CIMO 19DM288
88 Cladosporium aff．antarcticum CIMO 19DM259
${ }^{3}$ Cladosporium aff．crousii CIMO 19DM281
Cladosporium aff．chasmanthicola CIMO 19DM310
Cladosporium sp． 1 CIMO 19DM165
100 Cladosporium aff．variabile CIMO 19DM072
－KJ596569 Cladosporium halotolerans CBS119416
92 Cladosporium aff．endophytica CIMO 19DM280
Cladosporium aff．verrucocladosporioides CIMO 19DM092
［KX287300 Pseudocercospora macadamiae CBS 133432


100 Pseudocercospora cladosporioides CIMO 19DM040
Pseudocercospora cladosporioides CIMO 19DM039 Pseudocercospora aff．cladosporioides CIMO 19DM307


Myco 100 Acrodontium aff．pigmentosum CIMO 19DM273

NR 154721 Acrodontium pigmentosum CBS 111111
－MH865099 Xenophacidiella pseudocatenata CBS 128776 Constantinomyces nebulosus CIMO 19DM149
100 NR 156201 Constantinomyces nebulosus CBS 117941
unassigned Dothideomycetes species 2 CIMO 19DM151
－NR 165601 Lembosiniella eucalyptorum CBS 144603
$\qquad$ ${ }_{99}$－unassigned Botryosphaeriales species CIMO 19DM171
－unassigned Dothideomycetes species 3 CIMO 19DM202


100 Endoconidioma aff．populi CIMO 19DM247
$\qquad$ NR 121303 Endoconidioma populi UAMH 10297

66 ${ }^{00}$－unassigned Dothideales species CIMO 19DM136 Aureobasidium pullulans CIMO 19DM275 91 Aureobasidium sp． 2 CIMO 19DM296
100 Aureobasidium aff．pullulans CIMO 19DM103 KT693733 Aureobasidium pullulans CBS 584.75
100 NR 145389 Valsaria spartii CBS 139070
Valsaria spartii CIMO 19DM148
99 ＿—＿NR 156668 Sympoventuria melaleucae CBS 143407


100 －KU220965 Venturia fuliginosa BJFU 140827－14
M8661789 Fagicola fagi strain CBS 621.84
99 unassigned Cucurbitariaceae species 1 CIMO 19DM050

## Results and Discussion: phylogeny of Dothideomycetes (cont.)

| Endo |
| :--- |
| Epi\&Endo |



## Results and Discussion: phylogeny of remaining taxa from the Pezizomycotina subphylum (cont.)

${ }^{100}$ Exophiala aff. eucalyptorum CIMO 19DM025 MH863133 Exophiala eucalyptorum strain CBS 121638 -aff. Celerioriella sp. CIMO 19DM162b
[unassigned Phaeomoniellales species 3 CIMO 19DM182
$\qquad$ unassigned Phaeomoniellales species 1 CIMO 19DM299 unassigned Phaeomoniellales species 1 CIMO 19DM250 unassigned Phaeomoniellales species 1 CIMO 19DM173

94
$\qquad$
88 unassigned Phaeomonieliales species 16018 Phaeomoniella pinifoliorum CBS 114903 NR 132003 Celerioriella prunicola CBS 120876 KY173394 Celerioriella petrophiles CPC 29256 unassigned Phaeomoniellaceae species 16 CIMO 19DM163 ${ }^{99}$ _unassigned Phaeomoniellaceae species 10 CIMO 19DM113 unassigned Phaeomoniellaceae species 11 CIMO 19DM226
84 unassigned Phaeomoniellaceae species 4 CIMO 19DM159 -Pseudophaeomoniella sp. 1 CIMO 19DM058 -NR 137965 Pseudophaeomoniella oleicola CBS 139192 -NR 137966 Pseudophaeomoniella oleae CBS 139191
99 -Pseudophaeomoniella aff. oleae CIMO 19DM053 Pseudophaeomoniella oleae CIMO 19DM271 4Pseudophaeomoniella oleicola CIMO 19DM121 ${ }_{63}$ Pseudophaeomoniella sp. 2 CIMO 19DM060
100 Aspergillus tennesseensis CIMO 19DM160 KU729039 Aspergillus versicolor ATCC 9577 ${ }^{67}$ NR 163530 Penicillium glabrum CBS 125543 ${ }^{55}$ Penicillium aff. glabrum CIMO 19DM265 MH862075 Penicillium patens CBS 260.87
$\qquad$ NR 137897 Penicillium sterculinicola CBS 122426 Penicillium aff. thomii CIMO 19DM285 Penicillium aff. yezoense CIMO 19DM308 -Penicillium aff. tardochrysogenum CIMO 19DM052
${ }^{100}$ MH864112 Penicillium ubiquetum CBS 126437
Penicillium aff. pancosmium CIMO 19DM278
10. MH862703. Penicillium antarcticum strain CBS 100492

53 Penicillium aff. radiatolobatum CIMO 19DM251
79 Penicillium aff. chrysogenum CIMO 19DM064
79 MH865983 Penicillium tardochrysogenum CBS 132200
99 HQ026745 Penicillium chrysogenum strain ATCC 10106 Penicillium chrysogenum CIMO 19DM162 100 「Tympanis sp. CIMO 19DM008

## Results and Discussion: phylogeny of remaining taxa from the Pezizomycotina subphylum


[MT449717 Phlyctema sp. WJL-2020a voucher MFLU:15-1243 -NR 155470 Neofabraea inaequalis CBS 326.75
73100 ¿Neofabraea sp. CIMO 19DM014

## 75 Phlyctema sp. CIMO 19DM295

100 -NR 165202 Lachnellula hyalina CBS 185.66
unassigned Hyaloscyphaceae species CIMO 19DM272 -NR 163783 Neopyrenopeziza nigripigmentata MFLU 16-0599 [unassigned Helotiales species CIMO 19DM150
99 unassigned Loramycetaceae species CIMO 19 DM062
100 MH859780 Sarocladium summerbellii CBS 430.70 Sarocladium summerbellii CIMO 19DM011 Coniochaeta sp. 1 CIMO 19DM244
MH855438 Coniochaeta lignicola CBS 267.33
99 _Coniochaeta sp. 2 CIMO 19DM264
99 NR 137037 Coniochaeta prunicola CBS 120875
00 [Biscogniauxia aff. mediterranea CIMO 19DM112
KT253493 Biscogniauxia sp. AC-2015 strain Bx26 NR 163308 Nonappendiculata quercina CBS 116061
9 [Nonappendiculata sp. 1 CIMO 19DM303
58 Nonappendiculata sp. 1 CIMO 19DM258
NR 160498 Terfezia morenoi MUB Fung-j251

Phacidiales

Leotiomycetes
Helotiales

Hypocreales Coniochaetales
| Pezizales

## Results and Discussion: phylogeny of Basidiomycota and of remaining Ascomycota taxa


0.50

## Conclusions

Twenty-three fungal species (out of 161) found to live both epiphytically and endophytically, w/ some being abundant

Phaeomoniellaceae $\rightarrow$ abundant, but understudied on olive trees; several unassigned species (novel taxa)

May species from this group play as climate change bioindicators and/or "tolerance inducers" in olive crops?

Further research is needed

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