Urban Trees’ Terpenoids: plant-host interactions in a challenging and changing environment

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«Secondary» plant metabolites belong to three main groups:

- Phenols
- Alkaloids
- Terpenoids
About terpenoids.....

.....also called **isoprenoids**, because they contain repetitions of the 5-C isoprene unit.

**Biosynthesis**

\[
\text{Acetyl-CoA} \quad \text{MAV} \quad \text{MEP}
\]

Depending on the number of C atoms, they are said:

- Monoterpenes – **C\textsubscript{10}** \(\leftrightarrow\) **VOLATILE!**
- Sesquiterpenes – **C\textsubscript{15}**
- Diterpenes – **C\textsubscript{20}**
- Triterpenes – **C\textsubscript{30}**
- Tetraterpenes – **C\textsubscript{40}**
Besides being precursors of phytohormones, photosynthetic pigments, electron carriers and membrane components, isoprenoids are also deeply involved in eco-physiological interactions:

- Plant – environment
- Plant – host
- Plant – plant
Volatile isoprenoids are thought to be involved in defence and chemical communication.....
...non-volatile isoprenoids (oleoresins) are not only bioactive molecules, but also valuable raw materials for the chemical and pharmaceutical industry, cosmetics, nutraceuticals and biofuels
Emission profiles of volatile terpenoids have been studied in two populations of Calabrian pine infested by the pine processionary moth (PPM)

Canolo Nuova

Bova Superiore
Plant plots were within the premises of the Aspromonte National Park, in the southmost part of continental Italy
• 1st sampling in February

• 2nd and 3rd samplings in March

• 4th and 5th samplings in April

• 6th sampling in August

Collection of pine needles was matched with the biological cycle of the PPM
GC-MS analysis - 1

- Sample preparation (head space):
  - Equilibration
  - Adsorption on SPME fiber
• GC-MS analysis - 2
Twenty-one volatile terpenoids were identified in the head space of Calabrian pine needles. Of these, bornyl acetate [(4,7,7-trimethyl-3-bicyclo[2.2.1]heptanyl) acetate] was the most frequently and selectively associated with the PPM infestation.
Genes from Calabrian pine encoding for the major biosynthetic enzymes, namely terpene synthases, are being isolated and characterised, and their expression in response to PPM infestation is being quantified.
On the Evolution and Functional Diversity of Terpene Synthases in the *Pinus* Species: A Review

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Profiling Volatile Terpenoids from Calabrian Pine Stands Infested by the Pine Processionary Moth

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Terpenoids for biocontrol in UPF: prospective projects - 1

Graphical concept of UTreeTer showing the overall objective (i.e. the role of terpenoids in the interactions among major tree species of Italian cities, their arthropod pests and pathogens, and natural enemies of these organisms), the organization in workpackages (WPs), and the involved research units.
The UTreeTer project: terpenoids in a north-south transect of Italian UPF species and their hosts, in a changing climate

[i]tree/pathogen/pest/pest’s natural enemies[/i]

(i)  *Pinus* spp. (pine)/Sphaeropsis sapinea/Thaumetopoea pityocampa/Phrixue caudata, Villa brunnea, Calosoma sycophanta;

(ii)  *Quercus ilex* (holm oak)/Phyllosticta spp., Microsphaera spp./Lymantria dispar dispar, Thaumetopoea processionea, Corythucha arcuata, Coroebus spp./P. caudata, V. brunnea, Oencyrtus pytiocampae;

(iii)  *Platanus* × *acerifolia* (plane tree)/Apiognomonia platani/Corythucha ciliata/Anthoconis spp., Orius laticollis.

(iv)  Special attention will be also given to *Aesculus hippocastanum* (horse chestnut) and *Populus* spp. (poplar).
Terpenoids for biocontrol in UPF: prospective projects - 2

TerBioFor - Constitutive and host-inducible terpenoids as prospective biocontrol agents in UPF
Thank you very much for your consideration!