Is the germination stimulant of *Orobanche cumana* a strigolactone?

Danny Joel, Dina Plakhine, Hamam Ziadna
ARO, Israel

Swapan Chaudhuri and John Steffens
Cornell University, USA
Orobanche seeds require a nearby host roots for their germination.

Jean-Pierre VAUCHER, pasteur & botaniste (1763-1841)
Natural strigolactones

Plant hormones that are secreted by plant roots

Several other groups of plant metabolites may also act as germination stimulants.
Several other groups of plant metabolites may also act as germination stimulants.

Examples:

- Peagol
- Cumarin
- Ethylene
- Dihydrosorgoleone
- Isothiocyanates
- Polyphenols
The various plant species release numerous different compounds into the rhizosphere.

- Carbohydrates
- Enzymes
- Amino acids
- Amides
- Aliphatic acids
- Phenolics, sterols
- Aromatic acids
- Strigolactones
- Etc.
Seeds of the various broomrape species respond differently to crude root exudates of different plants.
O. *cumana* seeds specifically respond to sunflower root exudates.
O. cumana seeds specifically respond to sunflower root exudates

What is the O. cumana germination stimulant? Is it a strigolactone?
We have shown that the sesquiterpene lactone

**Dehydrocostus Lactone (DCL)**

Which is structurally differs from the strigolactones

is released to the rhizosphere of sunflower plants

and significantly stimulates *O. cumana* germination

Joel et al. (2011) Phytochem. 72:624–634
DCL was isolated and identified by Swapan Chaudhuri in John Steffens’ Lab as part of a BARD projects in 1992-95.
HPLC profiles of DCL

Root extracts

Root Exudates

Stimulant

Joel et al. (2011) Phytochem. 72:624–634
In order to prove that the sunflower germination stimulant for *O. cumana* is indeed DCL, and not a strigolactone, which may also be released by sunflower roots,

**Three key aspects have been clarified:**
1. Does DCL from another source stimulate *O. cumana* germination?

---

![Graph of germination vs. Log [M] for *O. cumana* and *P. aegyptiaca*](image)

**Sunflower DCL**

**Costus DCL (sigma)**

Joel et al. (2011) Phytochem. 72:624–634
2. Does inhibition of DCL biosynthesis prevent germination stimulation?

<table>
<thead>
<tr>
<th>Control</th>
<th>Mevastatin</th>
<th>Fluridone</th>
</tr>
</thead>
<tbody>
<tr>
<td>No inhibitor</td>
<td>Inhibitor of DCL biosynthesis</td>
<td>Inhibitor of strigolactone biosynthesis</td>
</tr>
<tr>
<td>1 μM</td>
<td>10 μM</td>
<td>10 μM</td>
</tr>
<tr>
<td>25 μM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*O. cumana* seed germination in the sunflower rhizosphere

Joel et al. (2011) Phytochem. 72:624–634
3. How does phosphate starvation affect DCL exudation in sunflower?

Joel et al. (2011) Phytochem. 72:624–634
We have shown that DCL is indeed the specific stimulant for *O. cumana*

- Released to the rhizosphere of sunflower plants
- Product of the mevalonate biosynthetic pathway
- Not affected by phosphate starvation
Different *O. cumana* populations
Differ in their relative germination response

Response to dilutions of root exudates

These results hint that DCL is not the only germination stimulant
of some *O. cumana* populations

Joel et al. (2011) Phytochem. 72:624–634
synthetic derivatives of dehydrocostus lactone (DCL) can stimulate germination of *Orobanche cumana*
Based on these results we suggest that

Similar to the strigolactone family of germination stimulants, a family of sesquiterpene lactones is released to the rhizosphere of the various sunflower cultivars (and possibly also by other plant species), and differentially stimulate the germination of various Orobanche populations.

Joel et al. (2011) Phytochem. 72:624–634
Swapan Chaudhuri and John Steffens
Cornell University, USA

Dina Plakhine, Hamam Ziadna, Danny Joel
ARO, Israel
Thank you