Project Uozone

WWTF project ESR17-027
(01/2018 –02/2022)

University of Natural Resources and Life Sciences, Vienna
Department of Forest and Soil Sciences

Diversity and interrelations among the constitutive

BVOC emission blends and changes during salt and drought stress

of four broad-leaved tree species at seedling stage

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Study goals and subjectives

- Effects of drought and salt stress on BVOC emissions on 4 different emitter types
  - *Changes of single BVOCs*
  - *Relate BVOC emissions to metabolic pathways and catabolic processes*
  - *Effects on herbivory and potential tropospheric ozone formation*

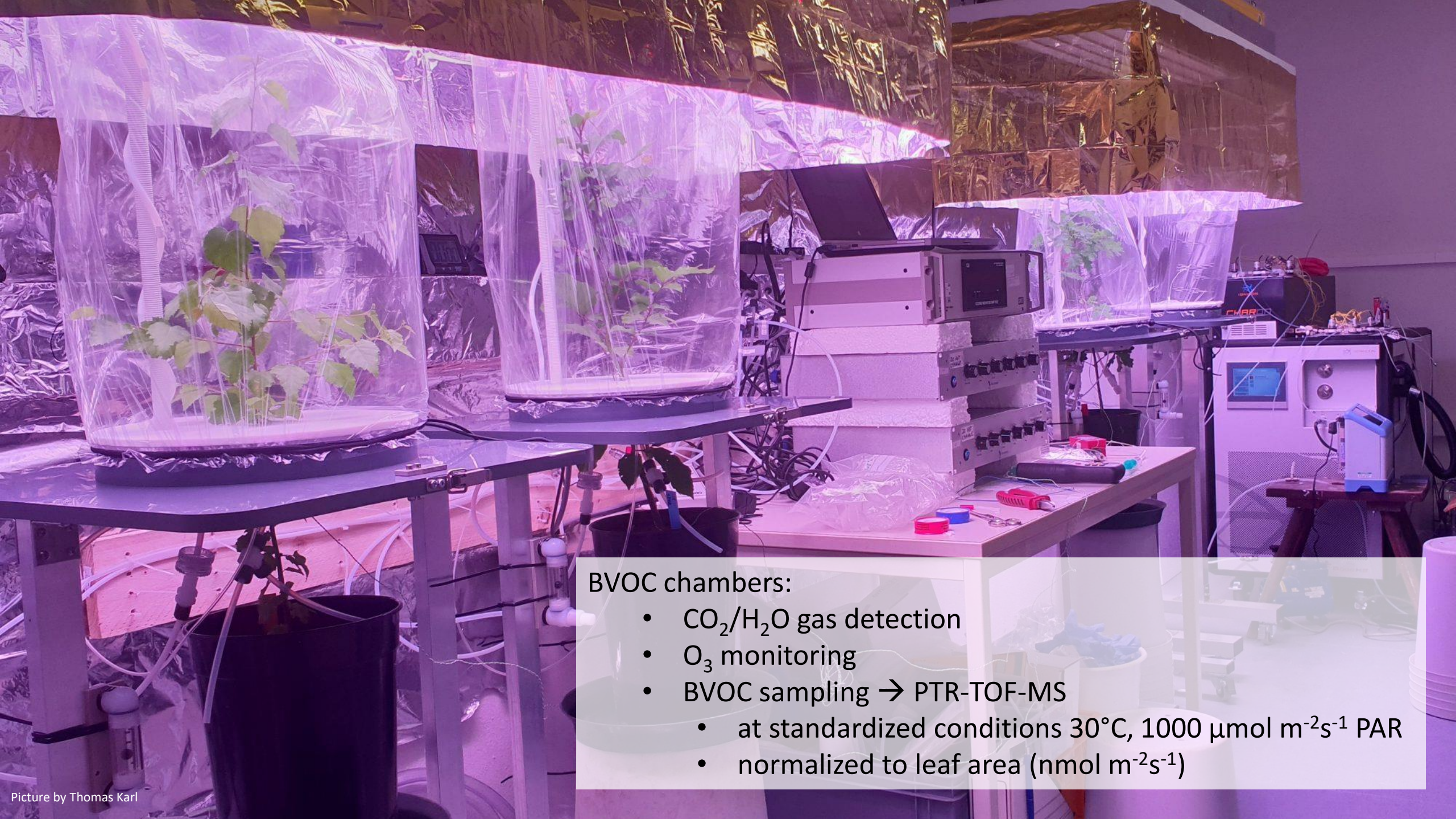
- 4 different main emitter types:
  - *Quercus robur* – isoprene (C_5)
  - *Fagus sylvatica* – MTs (C_{10})
  - *Betula pendula* – methanol, SQTs (C_{15})
  - *Carpinus betulus* – methanol, MT (C_{10})

Methods

- Drought stress: ~4 vol% soil water content for two weeks
  (13.4 vol% = 100 % field capacity)

- Salt stress: 50 mM NaCl infusion of soil two and one week prior

Salt stressed leaves

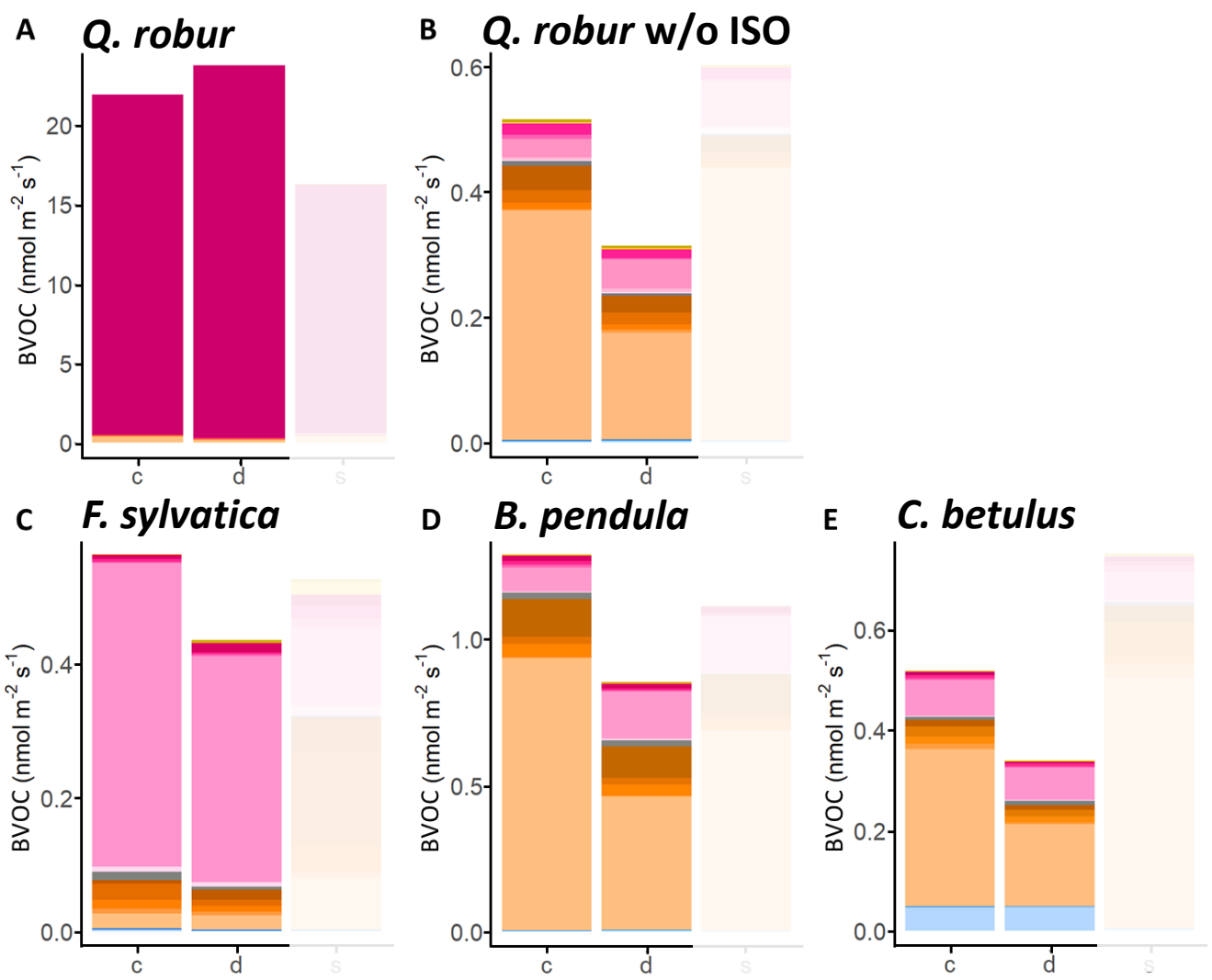


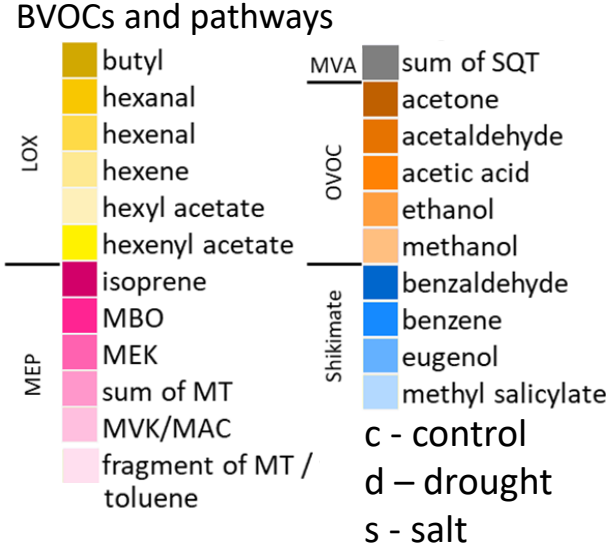
BVOC chambers:

- CO_2/H_2O gas detection
- O_3 monitoring
- BVOC sampling → PTR-TOF-MS
  - at standardized conditions 30°C, 1000 µmol $m^{-2}s^{-1}$ PAR
  - normalized to leaf area (nmol $m^{-2}s^{-1}$)

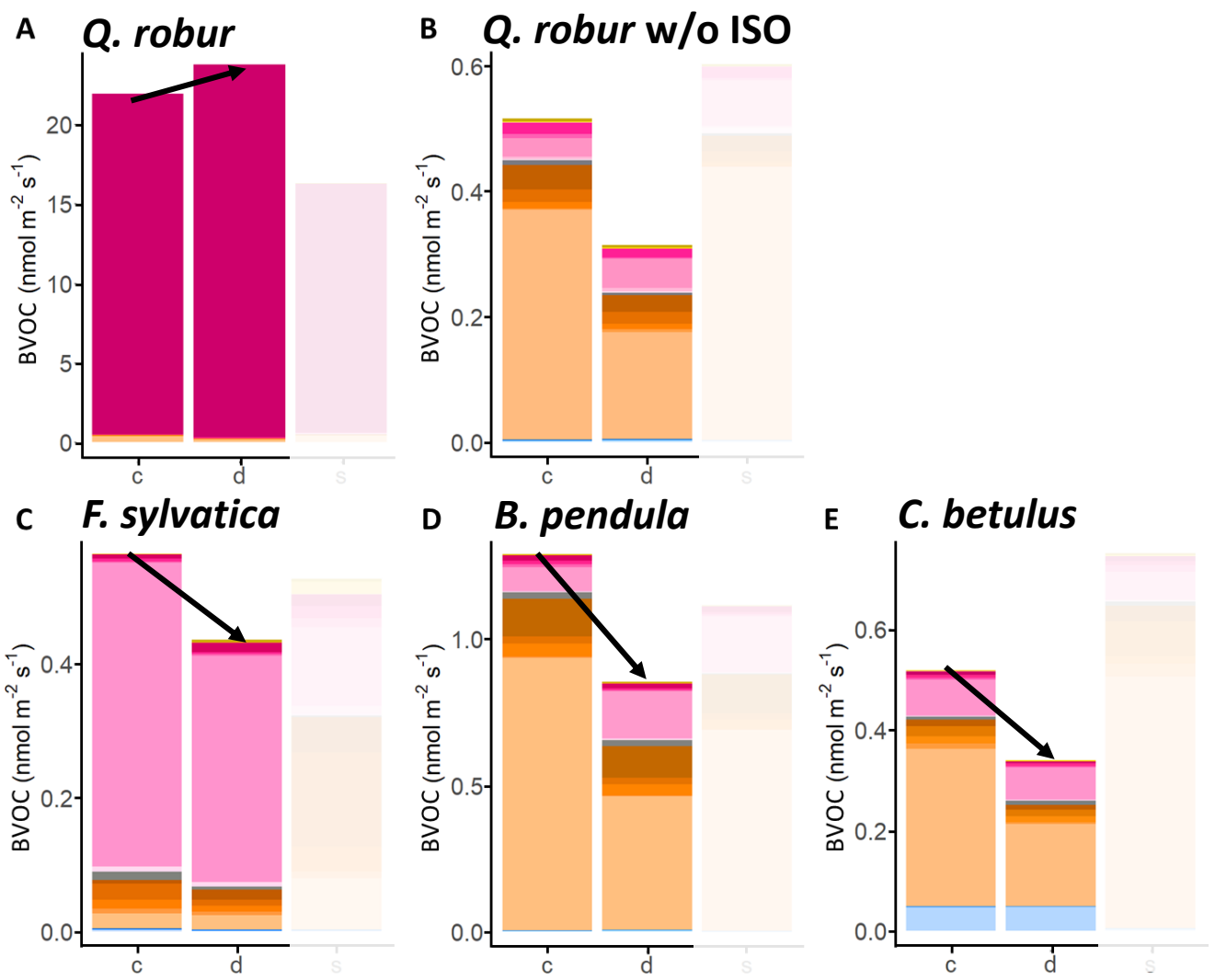
Picture by Thomas Karl

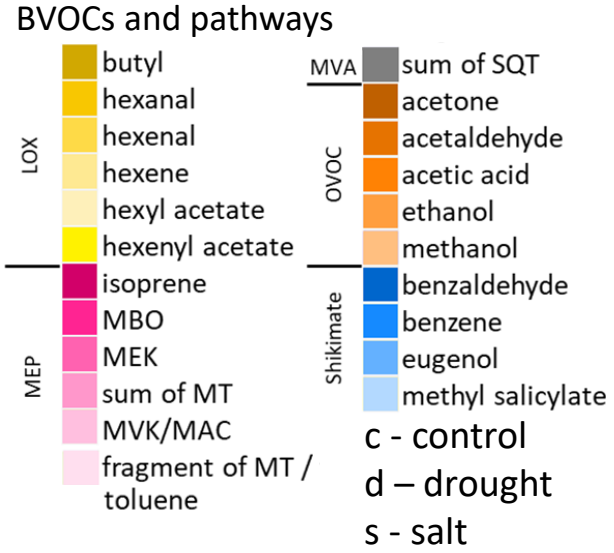
BVOC emissions under drought





BVOC emissions under drought



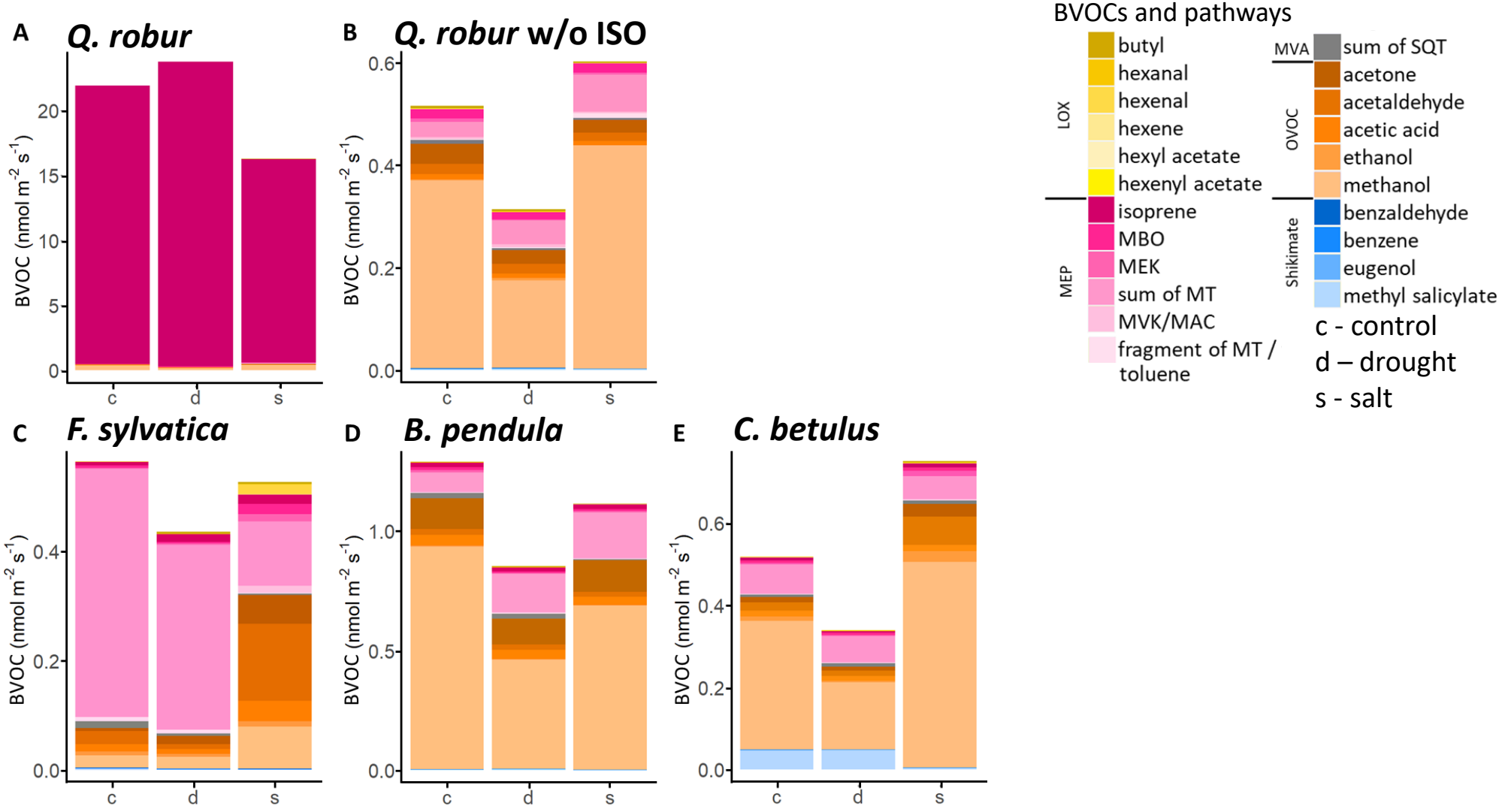


Increase of isoprene for *Q. robur* during drought

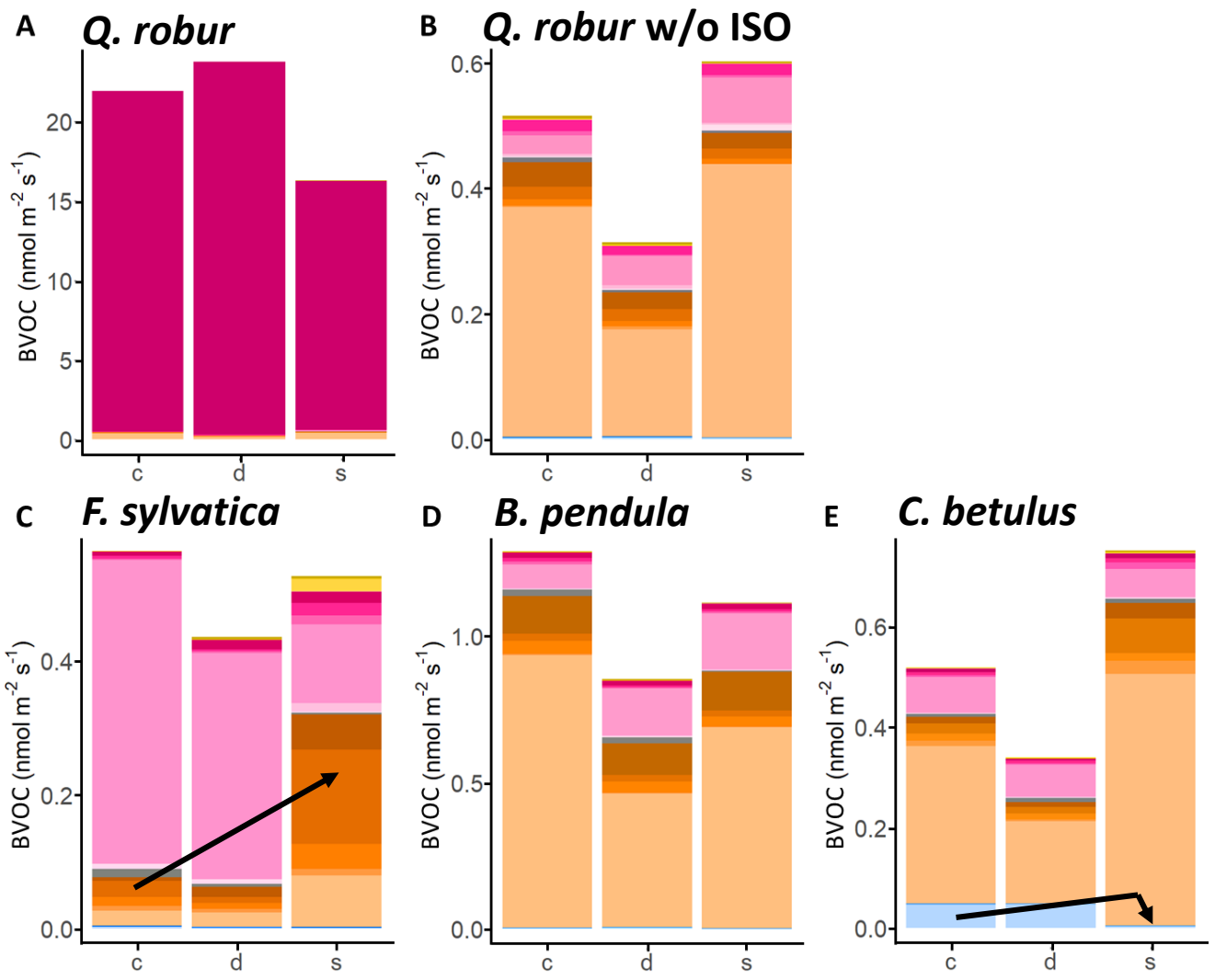
→ O_3 contributing?

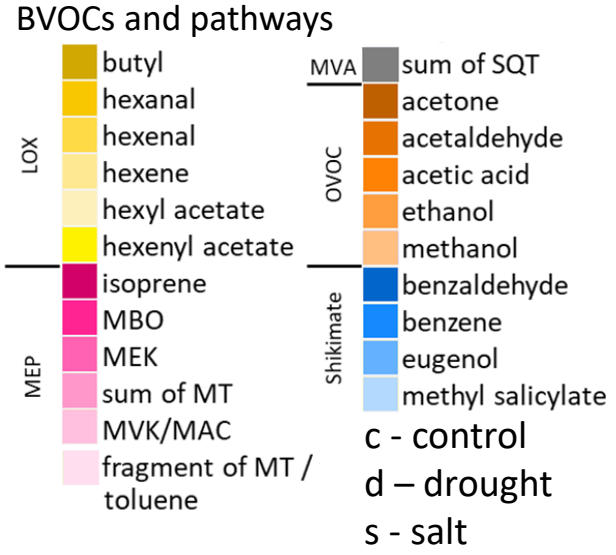
e.g. Xie et al. 2008

BVOC emissions under drought and salt stress



BVOC emissions under drought and salt stress





Increase of acetaldehyde
→oxidation of C_{18} fatty acids from cell membrane

Graus et al., 2004; Monson, 2013

Decrease of Shikimate-BVOCs
→ unexpected – due to salt stress mitigating properties

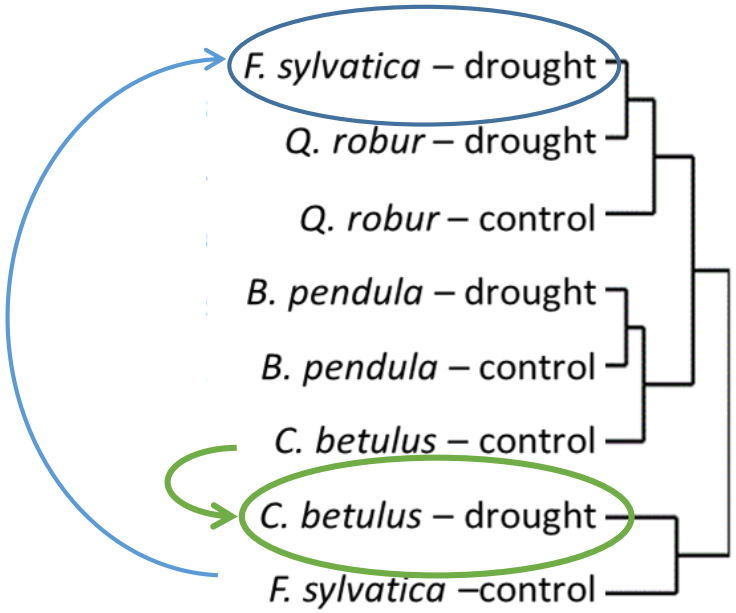
Jayakannan et al., 2015

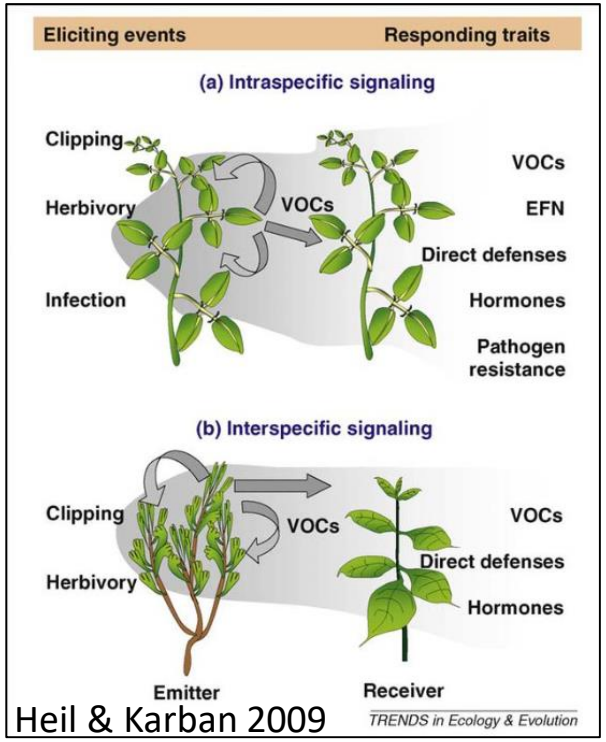
Bouquets of herbivory-related BVOCs

butyl, hexenal, hexenyl acetate, hexanal, hexyl acetate, hexene, acetaldehyde

according to Copolovici et al., 2014

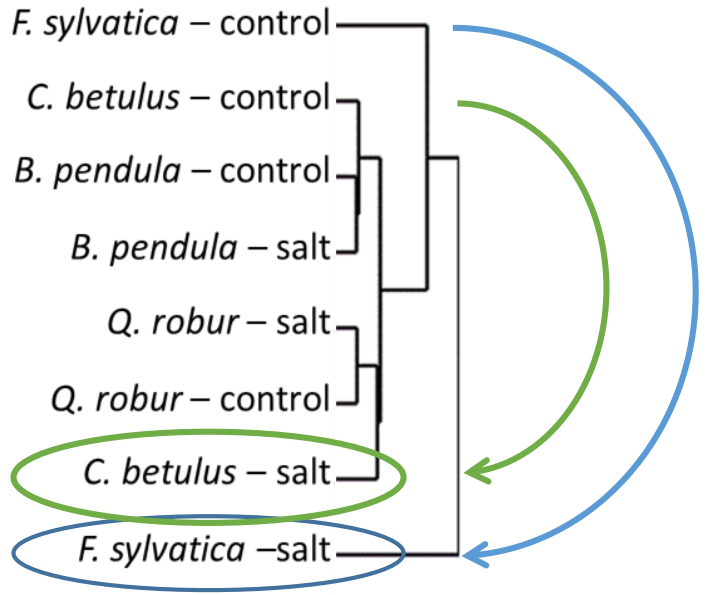
during drought





Heil & Karban 2009

during salinity



Hypotheses:

(1) Drought stress will lead to weaker warning signals and call for predators for *F. sylvatica* and *C. betulus*

(2) Salt stress leads to miss communication in salt-sensitive species *F. sylvatica* and *C. betulus*

Paper coming soon…

Same, same, but different: drought and salt stress effects on BVOC emission rates and blend compositions of four European tree species

Anne Charlott Fitzky, Lisa Kaser, Arianna Peron, Thomas Karl, Martin Graus, Daniel Tholen, Heidi Halbwirth, Michael Kurta, Silvija Marinovic, Heidelinde Trimmel, Maha Mahmoud, Mario Pesendorfer, Boris Rewald, Hans Sandén

→ Click on for supplementary results!

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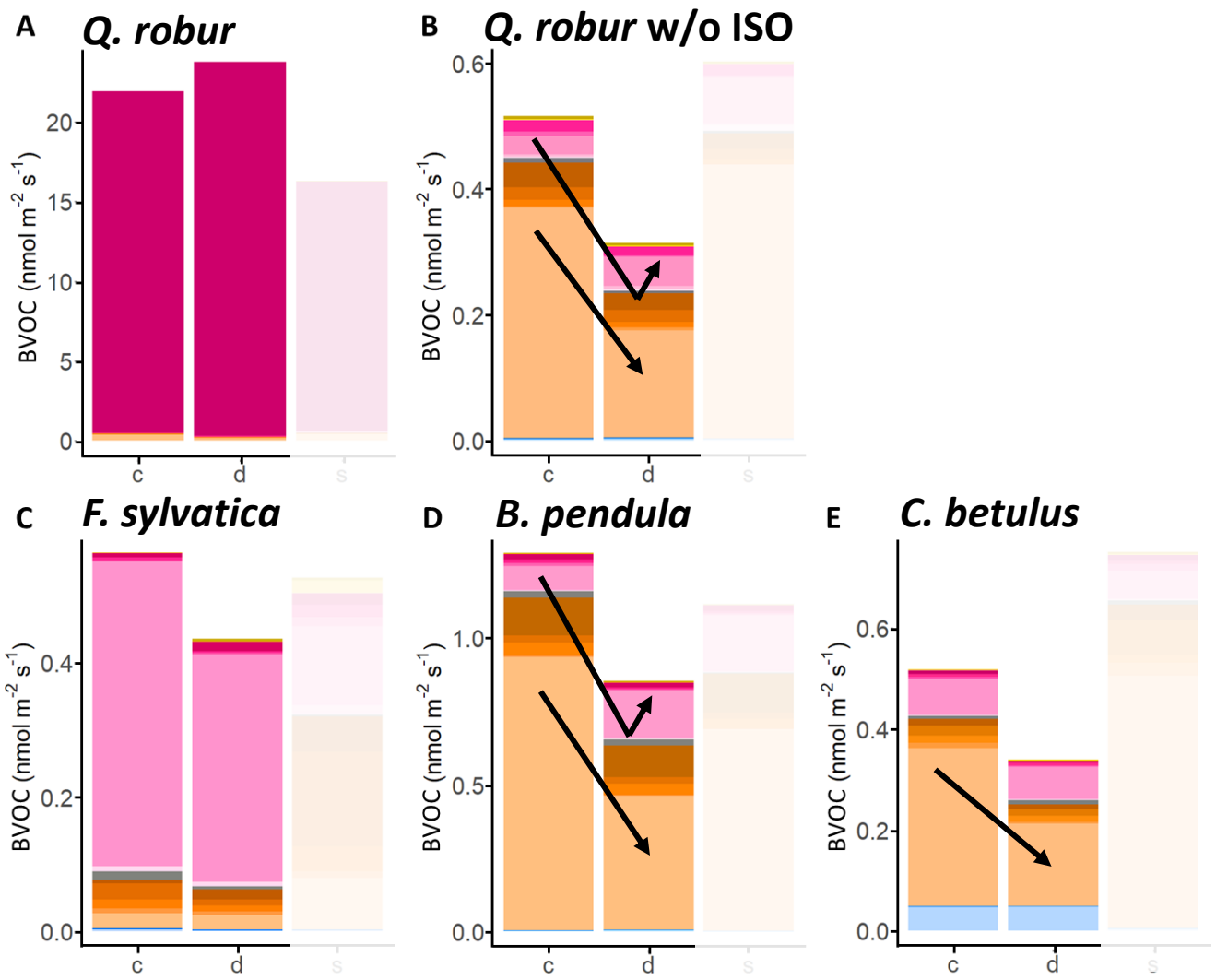
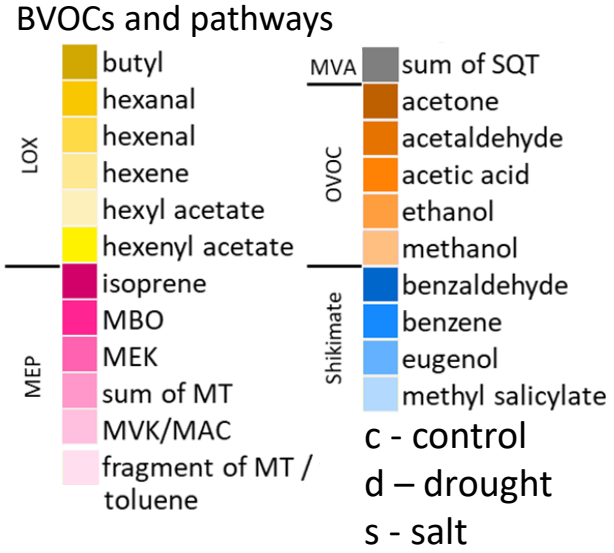
BVOC emissions under drought

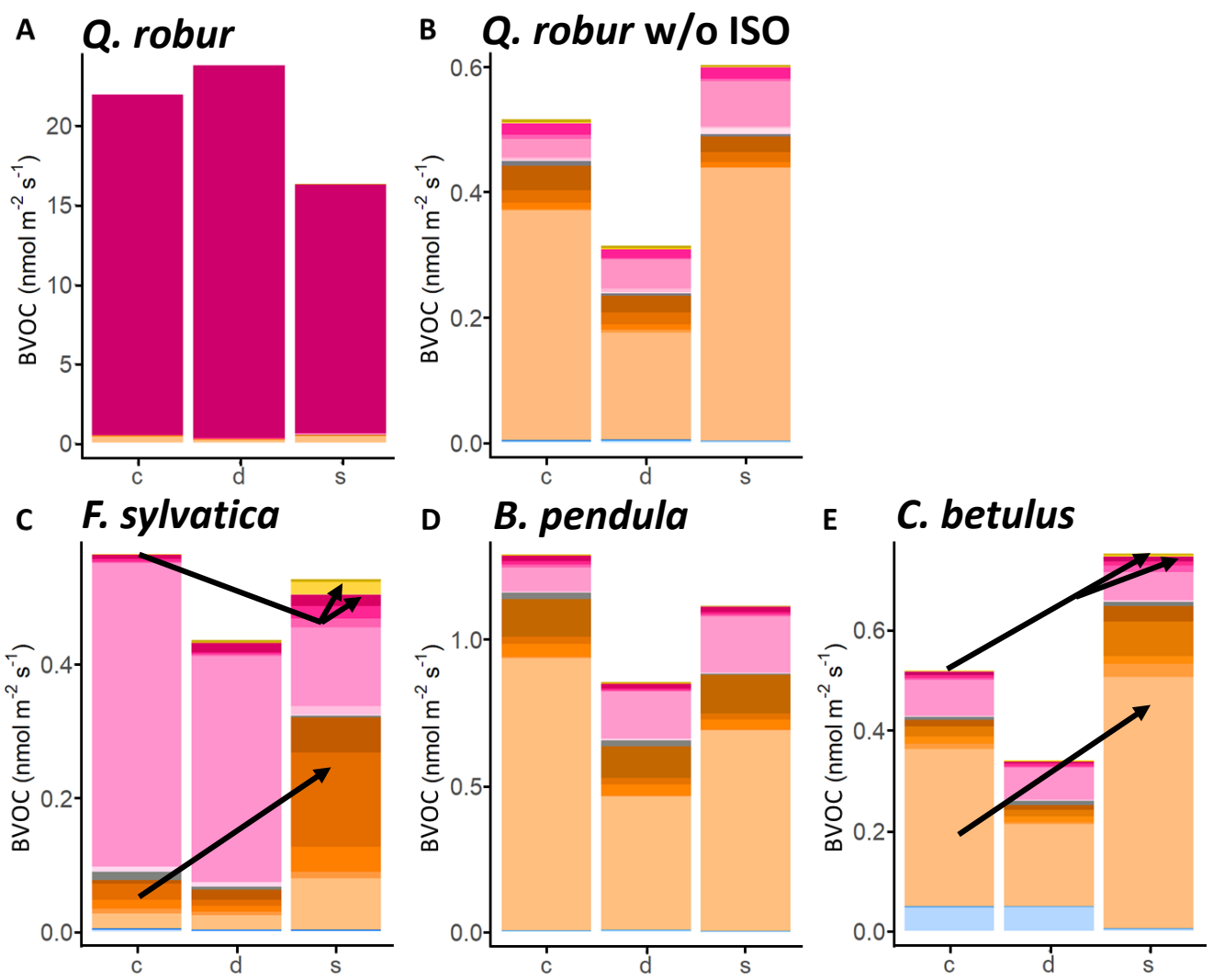


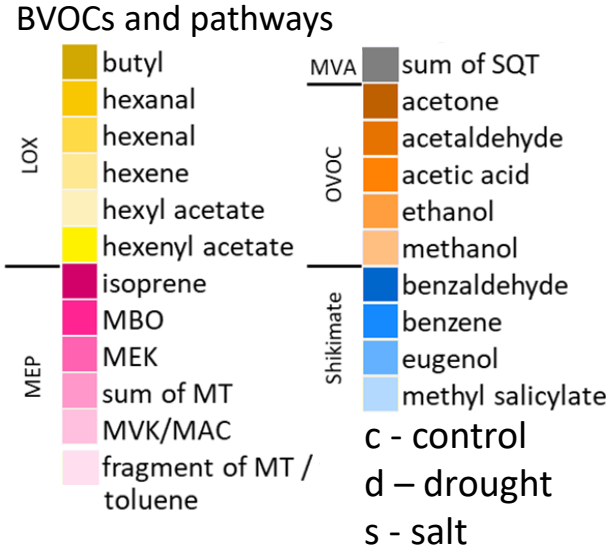


Enhanced MVA, Shikimate and MT-related MEP pathway
→ increased drought tolerance

Decreasing OVOCs
→‚less good‘ communciation

BVOC emissions under drought and salt stress





Enhanced LOX, Isoprene-related MEP pathway and OVOCs for MT-emitting tree species
→ ‚better' or different communciation?