A comparison of ozone sensitivity in urban tree species grown under free air ozone exposure

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Introduction

Tropospheric ozone (O_3) can impair physiological traits and growth of trees (Matyssek et al., 2013).

The classification of the sensitivity of trees to O_3 is useful to estimate a potential impacts of O_3 on trees for urban greening.

Here we have introduced the recent results of the response of photosynthesis and biomass to O_3 using a new-generation 3D Free-Air O_3 FACE.

Concluding Remarks

The classification of O_3 sensitivity for the species examined here is: i) highly sensitive: Oxford poplar clone, ii) moderately sensitive: *Quercus robur*, iii) less sensitive: *Q. pubescens*, iv) resistant: *Croton floribundus*, *Q. ilex, Schinus terebinthifolius.* We thus conclude that poplar should not used in cities at elevated O_3 risk, while the evergreen broadleaf *Q. ilex* and the two tropical species sound promising.

Experimental design

CNR campus at Sesto Fiorentino, Italy (43º49‘ N , 11º12’ E)

In 2015,

Species: Oaks (evergreen *Quercus ilex*, and deciduous *Q. pubescens and Q. robur*)

Three O_3 levels (24h mean)

1. Ambient (AA): 35.0 ppb
2. Ambient x 1.2 (1.2AA): 43.0 ppb
3. Ambient x 1.4 (1.4AA): 49.0 ppb

Three water levels

1. Well-watered (WW): 1.2 L/day
2. Intermediate (WM): 0.6 L/day
3. Water-stressed (WS): 0.12 L/day

In 2016,

Species: Oxford poplar clone (*Populus maximoviczii* Henry × *berolinensis* Dippel)

Two tropical tree species (deciduous C*roton floribundus* and evergreen *Schinus terebinthifolius*)

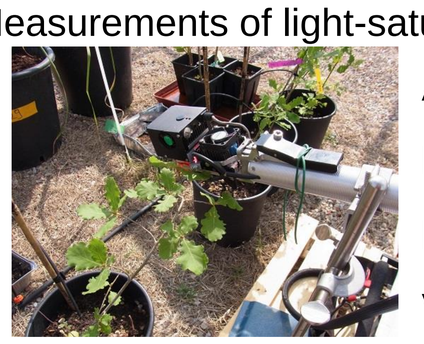
Three O_3 levels (24h mean)

1. Ambient (AA): 35.0 ppb
2. Ambient x 1.5 (1.5AA): 51.6 ppb
3. Ambient x 2.0 (2.0AA): 66.7 ppb

Water regime

Only well-watered condition

-Measurements of light-saturated net photosynthetic rate (A_{sat})



August-September

PPFD: 1500 μmol m^{-2} s^{-1}

Leaf temperature:25° C,

VPD:1.2 kPa, CO_2: 380ppm

-Harvest and assessment of biomass

October

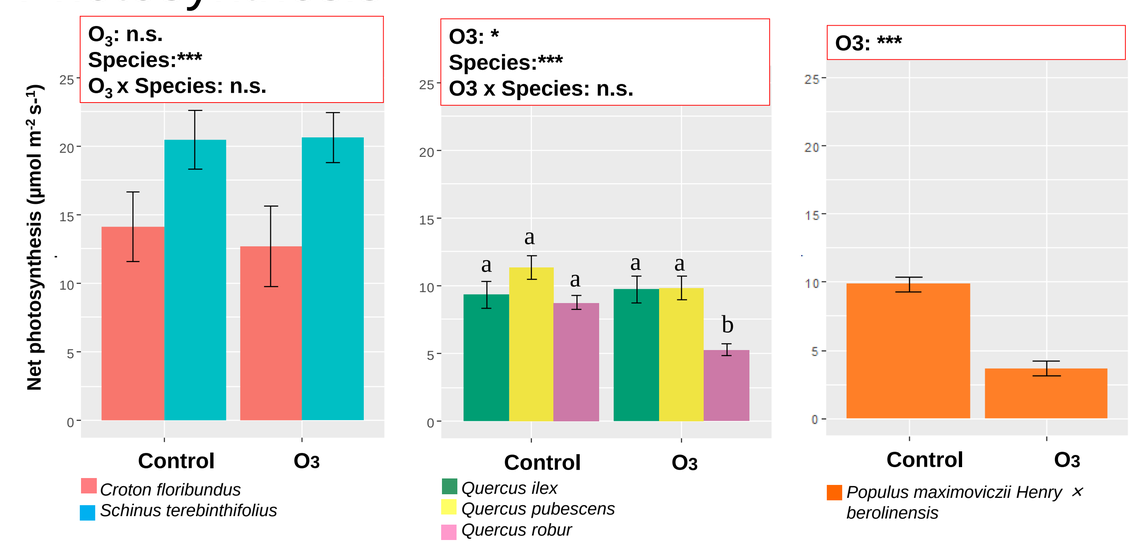
Assessments of Drymass

-Leaves, Shoots, Roots (fine, course roots)

After that, flux-based dose-response relationship was established for the risk assessment of biomass reduction by O_3.

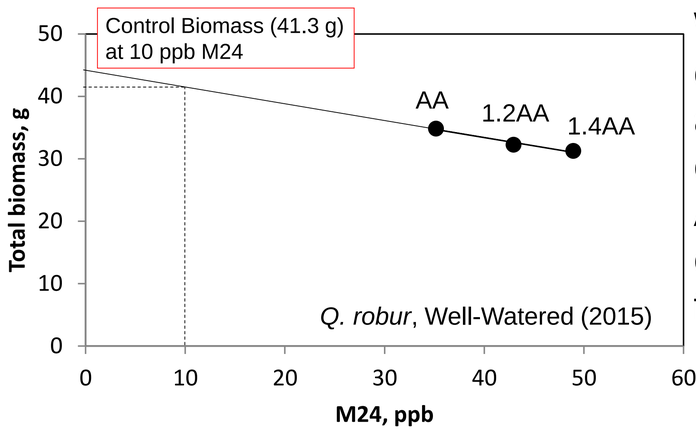
Results

-Photosynthesis



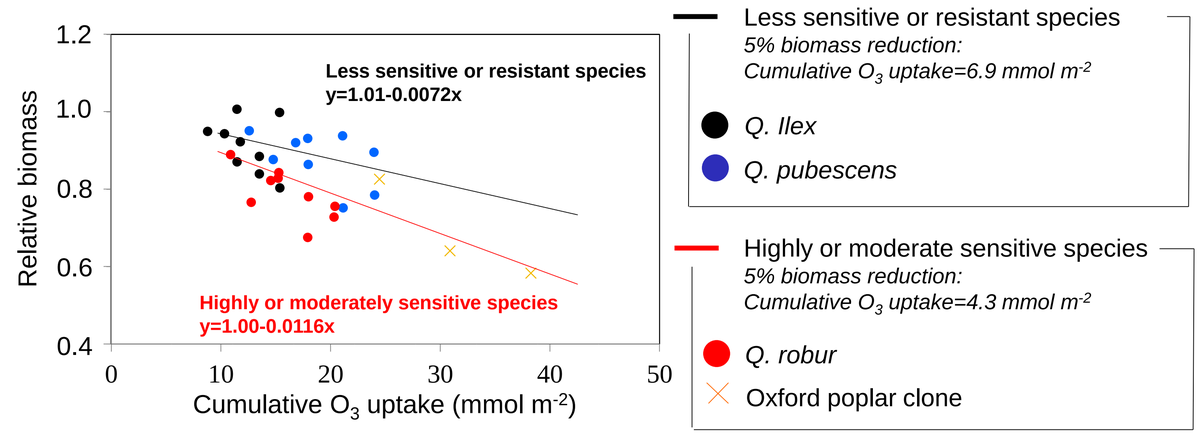
In 2015, ozone reduced photosynthetic rate in *Quercus robur* ($p=0.023$) and had a strong negative effect on the photosynthetic activity of the Oxford poplar clone ($p<0.001$). No effects were observed for the tropical species.

-Risk assessments of O_3 effects on biomass



We employed the hypothetical clean air (10 ppb as daily ave. at the pre-industrial level) to calculate the control biomass. According to this value, we estimated the relative biomass for the risk assessment.

Stomatal O_3 uptake is closely related to O_3 injury.
An innovative flux-based dose-response relationship was established.



Q. ilex: limited O_3 uptake, ***Q. pubescens***: higher O_3 uptake but limited effects

Q. robur: higher O_3 uptake and reduced biomass

Oxford poplar clone: very high O_3 uptake and greater reductions of biomass

Acknowledgements

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