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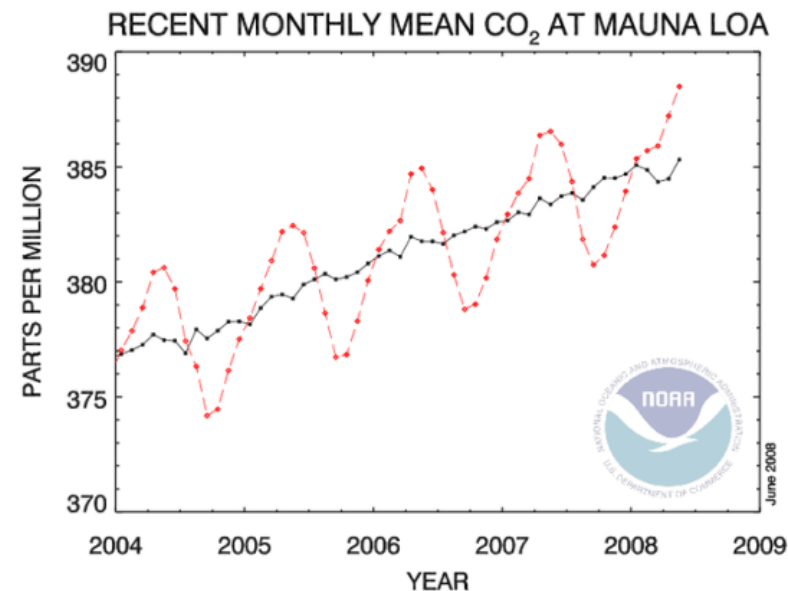
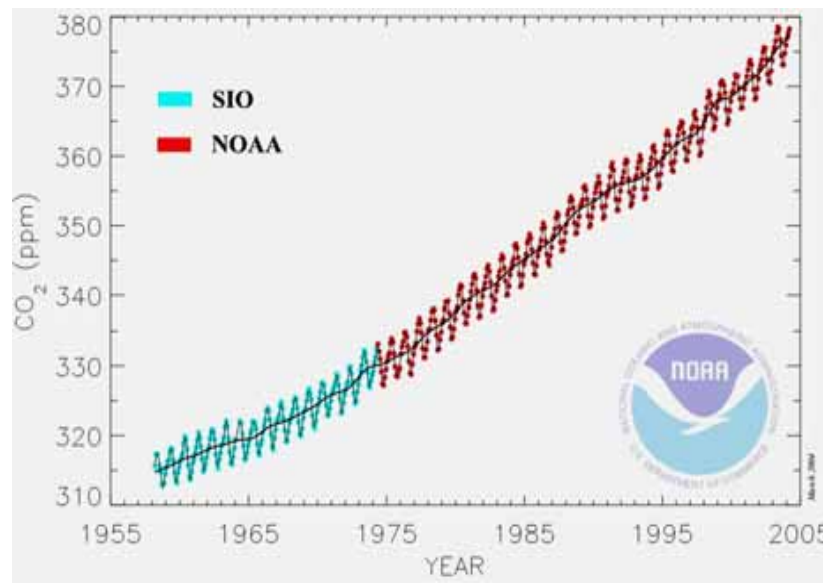
Effect of elevated CO₂ on the physiological adjustment and xylem structure of northern Japanese deciduous trees grown in a Free Air CO₂ Enrichment (FACE) system

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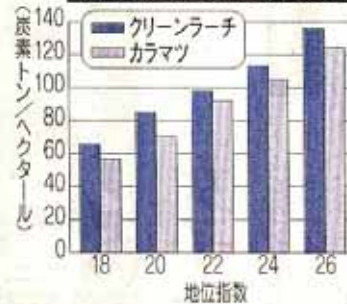
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<http://www.esrl.noaa.gov/gmd/ccgg/trends/>

科学

単位面積あたりの炭素固定量



40年生のクリーンラーチとカラマツで、単位面積あたりの炭素固定量を比較した。地位指数とは植栽場所が成長に適しているかを表す指標。数値が大きいほど成長に適している。いずれもクリーンラーチの炭素固定量が大きいことが分かる



クリ2年苗木

CO₂ may be reduced by breeding Technique in larch species! July 1st

CO₂吸収量多い新種

【本州中部に自生している。クイマツは、ダフリアカカラマツの変種でサハリンと千島列島に分布する。氷河期には北海道にも分布していたが、氷河期が終わる気温が上昇を目的と、北海道から姿を消した。カラマツの仲間が容易に種間交雑することが古くから知られており、ニホンカラマツとクイマツの交雑種である「クイマツ雑種F1」は、成長がニホンカラマツ並みによく、先枯病やネズミの食害に対する抵抗性、幹の通直性(曲がりにくさ)、材の重さ、強度がニホンカラマツより高いことなど、造林樹種として優れた特徴を持っていることがわかってきた。

クイマツ雑種F1は、まさに炭素固定能力が高いと期待される樹種である。品種改良のために植栽してきた樹木が三十年以上たち、材質検定可能な大きさに達した。また、温暖化対策の社会的ニーズが高まったことから、私たちは二〇三三年に炭素固定能力が高いクイマツ雑種F1の選抜に着手した。

Trees have big stem, and store fixed CO₂ for longtime.

優れた造林樹種
樹木が木部に固定する炭素量は、成長量と材の比重の二つで決まる。成長が早く、材が重くなるクイマツは、炭素固定能力が高くなる。道庁は木を「カ」と命名し、クイマツと命名した。5号」クイマツは、形質の親とすまカラマツ素固定能力が高くなる。



北海道の

森林

林木育種と温暖化対策

But, Can we expect the carbon sink capacity of trees in changing environment?

Contributors to the FACE studies 2002~



Prof. Funada G

Prof. Sasa G.

Contents

1. Research background

First goal:

2. Down regulation in photosynthesis

3. Introduction of FACE

Second goal

4. Stomatal regulation at high CO₂

5. Xylem formation in broadleaf trees

6. Conclusion and proposal

Photosynthetic rate was the same determined at growth CO₂ concentration.

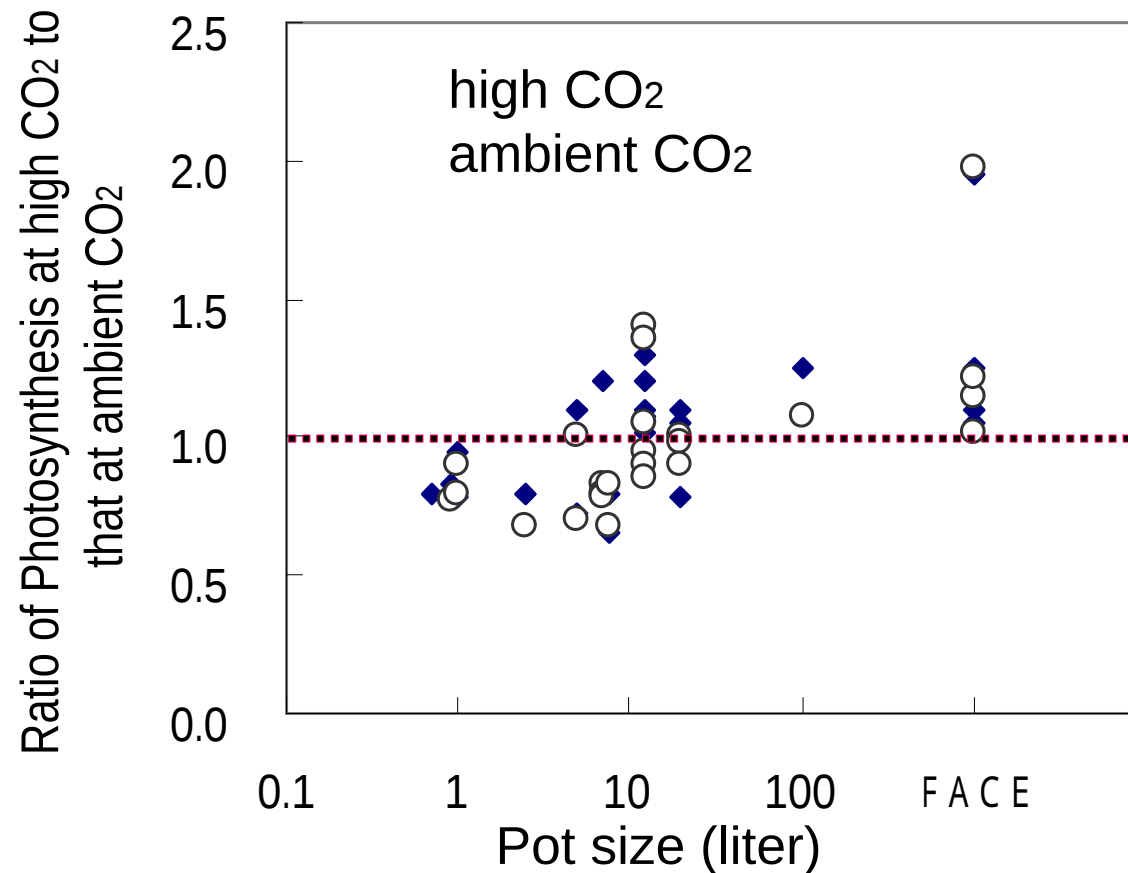
Photosynthetic response → adjustment

Down regulation

Why did photosynthetic adjustment occur?

- 1) Dilution of nitrogen in plant body
- 2) Extra-accumulation of starch
- 3) Depression of enzyme activity of amount

All “physiological adjustment” were artifacts!



Arp WJ (1991)

Plant, Cell &
Environment

13: 135-145

Root growth is
restricted by
pot !, which
brought imbalance
in sink-source

Effects of source-sink relations on photosynthetic acclimation to elevated CO₂.

FACE (Free Air CO₂ Enrichment)

11 deciduous tree species native to temperate region

RR2002



Sapporo
Experimental Forest

Mini-FACE
(Free Air CO₂ Enrichment)



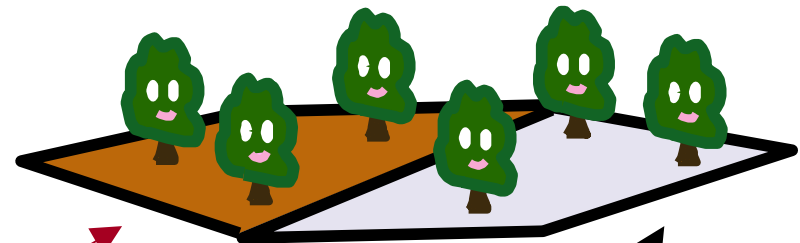
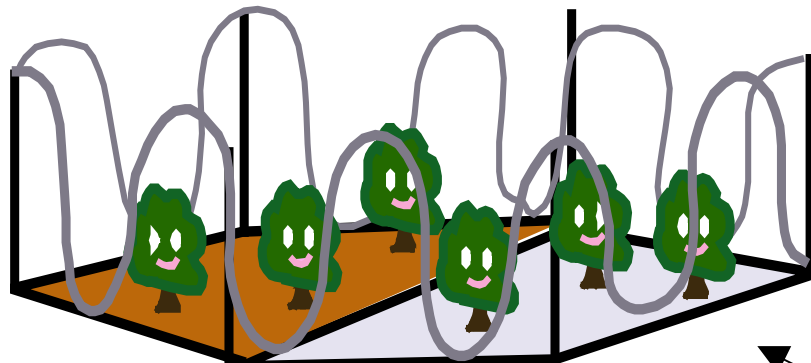
(Eguchi et al., 2004)

Treatments

[CO₂]

FACE
500ppmv

Control 370ppmv



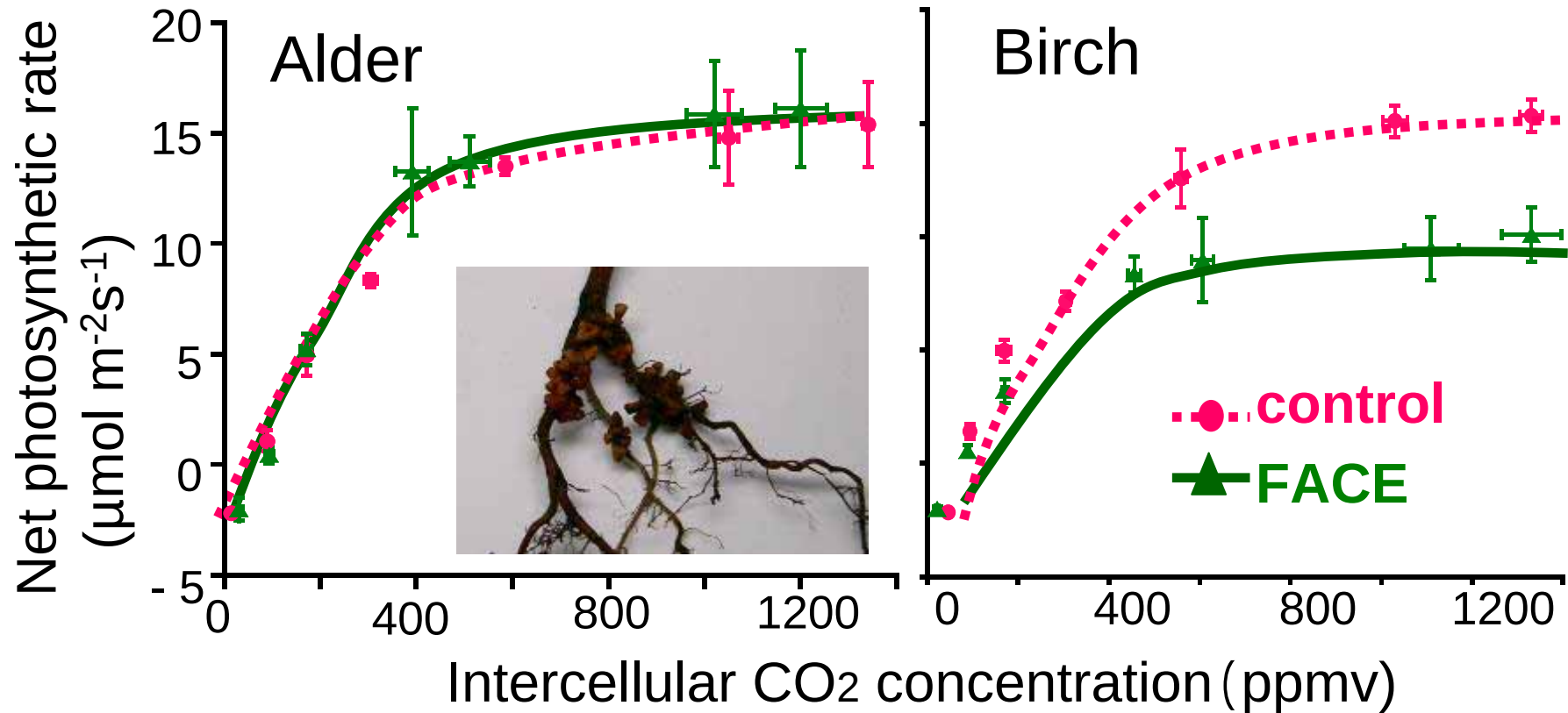
Soil condition

Brown forest soil
(Fertile soil)

Volcanic ash soil
(Infertile, P deficiency)

We prepared two soil conditions because the effects of high [CO₂] on plants depend on soil nutrient conditions.

Volcanic ash soil



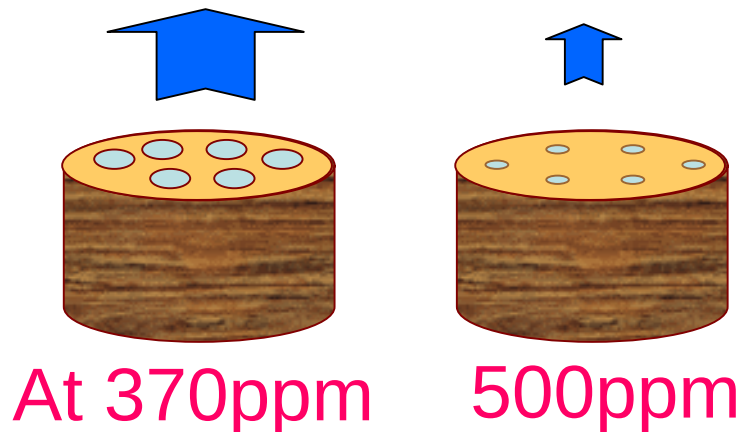
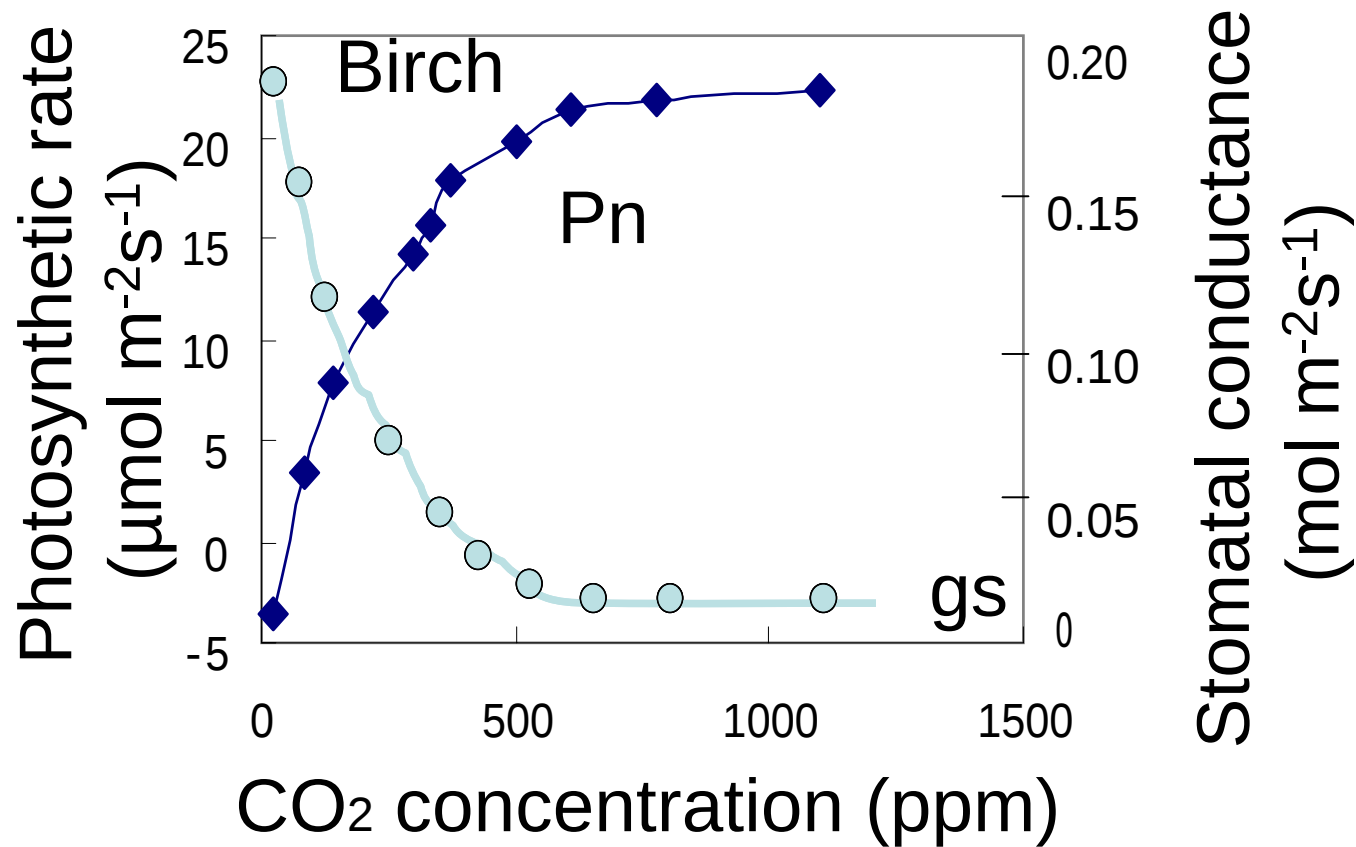
Even in FACE, birch showed clear down regulation,

Photosynthetic down regulation

Even in
without any restriction of root growth at FACE,
photosynthetic down regulation was found in
Birch grown at nutrient poor soil.

However, no down regulation was found in
Alder, which may be attributed to the activity of
symbiotic microorganisms, *Frankia* sp.

Frankia sp. may provide nitrogen to the root.
(Feed-forward regulation?!)



With increasing CO₂, stomatal conductance (gs) decreases.

It is expected that transpiration rate may decrease at high CO₂.

CO₂ affected only at sunny crown and reduced Transpiration rate in both species and soils.

(Eguchi et al. 2008 Trees)

It is expected that specific gravity of xylem at high CO₂ may increase because the proportion of “air” of vessel decreased.

Vessel diameter at 500ppm was smaller!

Stem mass increased only at fertile soil condition (brown forest soil).

No clear increase was found in specific gravity of stem

Water relations may be changed by CO₂.

With increasing CO₂, stomatal conductance decreased, which may change the xylem structure through the change in vessel diameter.

Decrease in vessel diameter was found at petiole and shoot level but not at stem level because an increase of leaves at high CO₂.

Increase of biomass of stem and branches was only observed at fertile soil conditions.

Thank you for kind attention !



Physiology of larch



Grazing
Damages by
Insects?



Decomposition
by macro-
Fauna?

On going studies