CO$_2$-assimilation light response curves of leaves;
some experimental data

by

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Introduction

For a survey of the great number of CO$_2$-assimilation light response curves measured at IBS between 1967 and 1972, it was decided to prepare a collection of these results in the form of an internal report.

Presented are all the data we were able to collect of leaf photosynthesis experiments, the conditions of which during measurement and plant pretreatment were well described. Whole plant and "crop" (a pot with a great number of plants) measurements have been excluded, and most of the leaf, plant and "crop" transpiration data. Results of effects of application of chemicals on the CO$_2$-assimilation have neither been included. The data were not selected for quality or any other subjective criterium.

All measurements were performed in the assembly at IBS, as described by Louwerse and Van Oorschot, Photosynthetica 3(1969)305-315. The experiments were designed by IBS research workers and performed with technical assistance of W. Louwerse and W. van der Zweerde. Some of the results included have been published or will be published. We
are grateful for the readiness of all in lending their results to this purpose.

Graphs are standardized as much as possible, and categorized. Many graphs concern two or more categories; these were placed in the category where its contribution seemed most illustrative. The section "miscellaneous data" contains examples of leaf versus plant and pot measurements and plant handling. Measuring conditions and pretreatment are given for each experiment. Numbering of leaves starts from the oldest leaf onwards.

Conversion tables of CO₂-assimilation rate units and light intensity units are added. It should be noted that in the graphs the incident light intensity is given. The intensity of the absorbed light is about 0.8 to 0.5 of the incident light, the exact value depending on leaf reflection and leaf transmission.
Species: Chloris gayana; Rhodes grass
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment on CO₂-assimilation
Pretreatment: climate room
   temperature see figures
   light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
   nutrient solution ½ Hoagland
Age: 5 weeks
Measurement: leaf, 25°C
Species: Zea mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment on CO$_2$-assimilation
Pretreatment and measurement: climate room, pretreatment 20°C, measurement 25°C
Age: 4 weeks

Light period 17 hrs, light intensity 0.08 cal cm$^{-2}$ min$^{-1}$
Species: Carthamus tinctorius; safflower, saffloer

Scientist: D. Zoebl

Experiment: Effect of temperature pretreatment on CO₂ assimilation

Pretreatment: climate room at 15°C, 20°C and 25°C

nutrient solution: Hoagland

light period 17 hrs, light intensity: 0.08 cal cm⁻² min⁻¹

Age: 40-44 days

Measurement: leaf
Species: Phaseolus vulgaris; brown bean
Scientist: Th. Alberda
Experiment: Effect of temperature on CO₂-assimilation
Pretreatment: Climate room 20° (or 25°C)
             light period 17 hrs;
             light intensity 0.08 cal cm⁻² min⁻¹
             nutrient solution ½ Hoagland
Age: 6 weeks
Measurement: leaf, temperature as indicated in figure
Species: Zea mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment on CO₂-assimilation
Pretreatment:
I  climate room 25°C
II 3 weeks 25°C, 1 week day 10°C, night 25°C
III 3 weeks 25°C
IV 3 weeks 25°C, 1 week day 10°C, night 25°C
light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Age: 4 weeks
Measurement:
I + II: 25°C
III + IV: 15°C
Species: Zea mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment on CO₂-assimilation at various CO₂-concentrations
Pretreatment: Climate room
20-20 = 4 weeks: day 20°C, night 20°C
10-20 = 3 weeks: day 20°C, night 20°C
1 week: day 10°C, night 20°C
light period 17 hrs; light intensity 0.08 cal cm⁻² min⁻¹
nutrient solution ½ Hoagland
Age: 4 weeks
Measurement: 1 leaf, 25°C; 300 and 1000 ppm CO₂
Species: Zea mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment and leaf-aging on CO₂-assimilation at various CO₂-concentrations
Pretreatment: climate room
  temperature: see below
  light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Age: 4 weeks
Measurement: temperature: see below
  measurement leaf 4 and 6

<table>
<thead>
<tr>
<th>Figure</th>
<th>Measurement temperature pretreatment</th>
<th>measurement temperature</th>
<th>CO₂</th>
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<tbody>
<tr>
<td>I</td>
<td>21 days 20°C 4 days 10°C 3 days 25°C/day 10°C/night 20°C</td>
<td>1000 ppm</td>
<td>1000 ppm</td>
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<tr>
<td>II</td>
<td>20°C</td>
<td>15°C</td>
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<tr>
<td>III</td>
<td>20°C</td>
<td>15°C</td>
<td>300 ppm</td>
</tr>
<tr>
<td>IV</td>
<td>21 days 20°C 4 days 10°C 3 days 25°C/day 10°C/night 20°C</td>
<td>300 ppm</td>
<td>300 ppm</td>
</tr>
<tr>
<td>V</td>
<td>20°C</td>
<td>25°C</td>
<td>1000 ppm</td>
</tr>
<tr>
<td>VI</td>
<td>21 days 20°C 4 days 10°C 3 days 15°C/day 10°C/night 20°C</td>
<td>1000 ppm</td>
<td>1000 ppm</td>
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<tr>
<td>VII</td>
<td>21 days 20°C 4 days 10°C 3 days 15°C/day 10°C/night 20°C</td>
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<td>300 ppm</td>
</tr>
<tr>
<td>VIII</td>
<td>20°C</td>
<td></td>
<td>300 ppm</td>
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</table>
Species: Zea mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment and leaf-aging on CO₂-assimilation
Pretreatment:
- Plant 1: climate room 25°C (4 full grown leaves)
- Plant 2: " 25°C (4 full grown leaves)
- Plant 3: " 20°C (3 full grown leaves)
Light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Nutrient solution ½ Hoagland
Age: 6 weeks
Measurement:
- Leaf, plant 1: 25°C
  " 2: 25°C
  " 3: 20°C
Species: Zea mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment and leaf-aging on CO₂-assimilation
Pretreatment:
I  20°C
II 19 days 20°C, 7 days 10°C, at night 20°C, 2 days 20°C
III 19 " 20°C, 8 " " " 1 day 20°C
IV 19 " 20°C, 9 " " " light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Age: 4 weeks
Measurement: 2 different leaves of one plant, 25°C
Species: Zea Mays; maize
Scientist: Th. Alberda
Experiment: Effect of temperature pretreatment and leaf-aging on CO₂-assimilation
Pretreatment: climate room temperature see figure
light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Age: ?
Measurement: leaf 25°C
Species: Stipa capensis
Scientist: Th. Alberda
Experiment: Effect of temperature on CO₂-assimilation
Pretreatment: climate room 20°C
  light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
  nutrient solution ½ Hoagland
  + last 2 weeks aeration
Age: 7 weeks
Measurement: shoot
Species : Phaseolus vulgaris; brown bean
Scientist : Th. Alberda
Experiment : Effect of temperature and CO₂-concentration on CO₂-assimilation
Pretreatment : climate room 25°C
light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
nutrient solution 1/2 Hoagland
Age : 3 weeks
Measurement : second ternate leaf, conditions see figure
Species : Zea mays; maize
Scientist    : Th. Alberda
Experiment  : Effect of temperature and CO₂-concentration on CO₂-assimilation
Pretreatment: climate room 25°C
light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
nutrient solution ½ Hoagland
Age         : 3 weeks
Measurement : leaf 6
Species: Zea mays, maize
Scientist: H. van Keulen, F.W.T. Penning de Vries
Experiment: Effect of temperature and CO₂ concentration on photosynthesis
Pretreatment: greenhouse + 20°C (July 1972) nutrient solution \( \frac{1}{2} \) Hoagland
Age: 18 days
Measurement: temperature: see figures leaf 4 300 ppm CO₂
Species: Lolium perenne 4N, ryegrass
Scientist: Th. Alberda
Experiment: Effect of light pretreatment on $\text{CO}_2$-assimilation
Pretreatment: greenhouse 15°C, climate room 15°C
light intensity 15°C 0.08 cal cm$^{-2}$ min$^{-1}$; light period 17 hrs.
nutrient solution: Hoagland
Measurement: youngest full grown leaf of vegetative shoots; temperature see figure
Age: greenhouse: planted 10 weeks
climate room: planted 3 months
0.35 cal. cm\(^{-2}\) min\(^{-1}\) during 13 days

0.35 cal. cm\(^{-2}\) min\(^{-1}\) during 11 days, 0.024 cal. cm\(^{-2}\) min\(^{-1}\) during 3 days

0.12 cal. cm\(^{-2}\) min\(^{-1}\) during 11 days

0.024 cal. cm\(^{-2}\) min\(^{-1}\) during 11 days, 0.35 cal. cm\(^{-2}\) min\(^{-1}\) during 11 days

0.024 cal. cm\(^{-2}\) min\(^{-1}\) during 12 days

Species: Phaseolus vulgaris; brown bean
Scientist: W. Louwerse
Experiment: Effect of light intensity pretreatment on CO\(_2\) assimilation
Pretreatment: climate room 20\(^\circ\)C
light period 17 hrs, light intensity: see figure
nutrient solution 1/2 Hoagland
Age: 18-21 days
Measurement: primary leaves (cotyledons) 25\(^\circ\)C
Species: Zea mays, maize; Phaseolus vulgaris, brown bean
Scientist: Th. Alberda
Experiment: Effect of light intensity pretreatment on CO₂-assimilation
Pretreatment: greenhouse 20°C
light intensity: see figures
nutrient solution \textsuperscript{1} Hoagland
Age: ± 4 weeks
Measurement: leaf 25°C
Species: Phaseolus vulgaris; brown bean
Scientist: W. Louwerse
Experiment: Effect of light intensity pretreatment on CO₂-assimilation
Pretreatment: artificial light
- climate room 20°C
- light period 17 hrs
- light intensity see figure
- nutrient solution ½ Hoagland
- sunlight
- open greenhouse
- light intensity see figure

Age: 14 days
Measurement: cotyledons 25°C
Species: Zea mays; maize
Scientist: W. Louverse
Experiment: Effect of light intensity pretreatment on CO₂-assimilation
Pretreatment: artificial light: climate room 20°C, light period 17 hrs, light intensity see figure; sunlight: open greenhouse; nutrient solution: ½ Hoagland
Age: 25 days
Measurement: leaf, 25°C
ul CO₂ cm⁻² hr⁻¹

•

/ 200

150

100

50

0

150

100

50

0

150

100

50

0

150

100

50

0

150

100

50

0

150

100

50

0

300 ppm CO₂

25°C

300 ppm CO₂

15°C

1000 ppm CO₂

25°C

1000 ppm CO₂

15°C
Species: Zea mays; maize, Phaseolus vulgaris; bean
Scientist: Th. Alberda
Experiment: Effect of light intensity pretreatment on CO₂-assimilation at various CO₂-concentrations
Pretreatment: Plants are grown at 20°C in climate rooms. Light intensity 100% corresponds with 0.2 cal cm⁻²min⁻¹

<table>
<thead>
<tr>
<th>Light Intensity (%)</th>
<th>Corresponding Light Intensity (cal cm⁻²min⁻¹)</th>
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<tr>
<td>40</td>
<td>0.08</td>
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<tr>
<td>22</td>
<td>0.044</td>
</tr>
<tr>
<td>14</td>
<td>0.028</td>
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</tbody>
</table>

Age: maize: 4 weeks
      beans: 3 weeks
Measurement: maize: 6th leaf
           beans: 3rd ternate leaf
temperature and CO₂-concentration see figure
**Species**: Phaseolus vulgaris; brown bean

**Scientist**: Th. Alberda

**Experiment**: Effect of light intensity pretreatment and leaf-aging on CO₂-assimilation at various CO₂-concentrations

**Pretreatment**:

**cotyledons**

- **I**: greenhouse 25°C, 1000 ppm CO₂
- **II**: climate room 23°C, light 0.08 cal cm⁻² min⁻¹, 1000 ppm CO₂
- **III**: greenhouse 25°C, 300 ppm CO₂
- **IV**: climate room 23°C, light 0.08 cal cm⁻² min⁻¹, 300 ppm CO₂

**ternate leaf**

- **I**: climate room 20°C, light 0.2 cal cm⁻² min⁻¹, 1000 ppm CO₂
- **II**: greenhouse 25°C, 1000 ppm CO₂
- **III**: greenhouse 25°C, 300 ppm CO₂
- **IV**: climate room 20°C, light 0.2 cal cm⁻² min⁻¹, 300 ppm CO₂

**Age**: three weeks

**Measurement**: leaf, 25°C; conditions are indicated in figure
Species : Helianthus annuus; sunflower
Scientist : W. Louwerse
Experiment : Effect of light-intensity pretreatment and leaf-aging on CO₂-assimilation
Pretreatment : greenhouse + 23°C
Nutrient solution: ½ Hoagland
Age : 2 months
Measurement : leaf, 25°C
  fig. 1. plant after 17 hrs. darkness
  fig. 2. plant after 0.5 hr darkness
ul CO$_2$ cm$^{-2}$ hr$^{-1}$

Species: Phaseolus vulgaris; brown bean
Scientist: W. Louwerse
Experiment: Effect of leaf-aging on CO$_2$-assimilation
Pretreatment: climate room 20°C
  light period 17 hrs; light intensity 0.08 cal cm$^{-2}$min$^{-1}$
Age: see figure
Measurement: cotyledons, 25°C
Species : Cucumis sativus; cucumber
Scientist : W. Louwerse
Experiment : Effect of leaf-aging on CO₂-assimilation
Pretreatment : climate room 20°C
light period 17 hrs; light intensity 0.08 cal cm⁻² min⁻¹
nutrient solution \( \frac{1}{2} \) Hoagland
Age : see figure
Measurement : first and second secondary leaves, 25°C
Species: Zea mays; maize
Scientist: W. Louwerse
Experiment: Effect of leaf-aging on CO₂-assimilation
Pretreatment: greenhouse 23°C, nutrient solution \( \frac{1}{2} \) Hoagland
Age: 10 weeks (plants have 14 leaves)
Measurement: leaf 25°C
Species: *Cannabis sativa; Hemp*
Scientist: Th. Alberda
Experiment: Effect of leaf-aging and plant density on CO₂-assimilation
Pretreatment: climate room 25°C, light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹, nutrient solution Hoagland treatment only in the last week
Age: 5 weeks
Measurement: leaf, 25°C
Species : Cannabis sativa; hemp
Scientist : Th. Alberda
Experiment : Effect of leaf-aging and plant density on CO₂-assimilation
Pretreatment : climate room 20°C
Light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Nutrient solution 1/4 Hoagland
Age : ?
Measurement : leaf 25°C
Species: Zea mays; maize
Scientist: F.W.T. Penning de Vries
Experiment: Effect of nitrate in nutrient solution on CO₂-assimilation
Pretreatment: Climate room 25°C
light period: 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
Nutrient solution:
- NO₃⁻ + ½ Hoagland
- NO₃⁻ - ½ Hoagland
  KNO₃ replaced by KCl
  Ca(NO₃)₂ replaced by CaSO₄
  Treatment started at first day of measurements
Age: 10 days
Measurement: Shoot, 25°C
Species: Avena sativa; oats
Scientist: W. Louwerse
Experiment: Effect of Potassium in nutrient solution on CO₂-assimilation
Pretreatment: Climate room 15°C
light period 17 hrs, light intensity 0.08 cal cm⁻² min⁻¹
nutrient solution:

<table>
<thead>
<tr>
<th></th>
<th>normal K</th>
<th>+K</th>
<th>-K</th>
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<tbody>
<tr>
<td>MgSO₄</td>
<td>0.5 mmol</td>
<td>normal K</td>
<td>0.5 mmol</td>
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<td>KH₂PO₄</td>
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<td>+</td>
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<td>KNO₃</td>
<td>1.25</td>
<td>1.87 mmol</td>
<td>1.88</td>
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<tr>
<td>Ca(NO₃)₂</td>
<td>1.25</td>
<td></td>
<td>Ca(NO₃)₂</td>
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</table>

Age: 2 months
Measurement: Leaf 25°C
Species : Zea mays; maize
Scientist : W. Louwerse
Experiment : Effect of Potassium in nutrient solution on CO₂-assimilation
Pretreatment : climate room 20°C
  light period 17 hrs; light intensity 0.08 cal cm⁻² min⁻¹
  nutrient solution
  normal K
    0.5 mmol MgSO₄
    0.25 KH₂PO₄
    1.25 KNO₃
  +K
    1.87 mmol K₂SO₄
  -K
    1.88 Ca(NO₃)₂

Age : 1 month
Measurement : leaf 25°C
Species: Phaseolus vulgaris; brown bean
Scientist: W. Louwerse
Experiment: Effect of removing apex "sink" on CO₂-assimilation
Pretreatment: Climate room 20°C
 light period 17 hrs, light intensity 0.08 cm⁻² min⁻¹
 apexes are removed at age of 1 week
Age: see figure
Measurement: Whole plant 25°C
Species: Zea mays, maize
Scientists: H. van Keulen, F.W.T. Penning de Vries
Experiment: Effect of relative water content on photosynthesis
Pretreatment: greenhouse + 20°C (July, 1972) nutrient solution \( \frac{1}{4} \) Hoagland
Age: 18 days
Measurement: leaf 4, 300 ppm CO\(_2\), light intensity 0.5 cal. cm\(^{-2}\) min\(^{-2}\)

\( \mu g \text{ CO}_2 \text{ cm}^{-2} \text{ hr}^{-1} \)

Rel. water content = 1.00 at \( \pm 5.7 \text{ g H}_2\text{O/g dry matter} \)
$\mu g CO_2 cm^{-2} hr^{-1}$

- **AMARANTHUS**

**Graphs for AMARANTHUS**

- **Pot 65**
  - $I_{j} - 10$
  - $II_{j} - 5$
  - $+III_{j} - 5$
  - $IV_{j} - 7$
  - $V_{j} - 6.5$

- **Pot 45**
  - $IV_{j} - 7.5$
  - $III_{j} - 5$
  - $II_{j} - 7.5$
  - $V_{j} - 4.5$

- **Pot 52**
  - $III_{j} - 10$
  - $II_{j} - 8$
  - $I_{j}$
  - $\Delta V_{j} - 6.5$
  - $IV_{j} - 3$

- **Pot 59**
  - $I_{j} - 10 (\times)$
  - $III_{j} - 8$
  - $II_{j} - 6.5 (\times)$
  - $IV_{j} - 10 (\circ)$
  - $\Delta V_{j} - 7$
Species: Amaranthus hybridus cv "NON DAM"

Scientists: L. Stroosijnjder and F.W.T. Penning de Vries

Experiment: Effect of leaf water potential on photosynthesis

Pretreatment: greenhouse 25°C, relative humidity ± 60 %, light intensity 17,000 lux grown on 5 ltr pots with loam relative water content pot 65 11 % ( -0.50 bar )
          " 45  15.5 % ( -0.25 " )
          " 52  6 % ( -2.50 " )
          " 59  20 % ( -0.15 " )

Age: 3 months

Measurement: Leaf, 25°C.

Plants dried the soil from day I till day V; leaf water potentials are indicated in the figure in arabic numbers (unit: bar).

Leaf water potential is determined by vapour exchange method.
\[ \mu g \text{ CO}_2 \text{ cm}^{-2} \text{ hr}^{-1} \]

**Fig. 1**

**Fig. 2**

**Fig. 3**
Fig. 1
Triticum aestivum (Artois × Mexico 43), summer wheat
Plants are grown in climate room at 16°C
Stage: flag leaf full grown, first ears appear
Measurement: flag leaf, 25°C

Fig. 2
Triticum aestivum (Jufy), summer wheat
Plants are grown in climate room at 15°C
Stage: flag leaf full grown, first ears appear
Measurement: flag leaf, 25°C

Fig. 3
Triticum aestivum (Opal, Orca)
Plants are grown in climate room at 15°C
Stage: Opal 10^+ - 10.1 (first ears appear)
         Orca  9 - 10  (1 flag leaf full grown)
Measurement: flag leaf, 25°C
Scientist: G. Dantuma

Fig. 1

Triticum aestivum, wheat
Plants are cultivated in pots in the field
Stage:
- T. aestivum (opal) 10-4.2
- T. aestivum (dicoccum) 10
- T. aestivum (spelta) 10
- T. aestivum (timopheevi) 10

Measurement: last leaf but one, 25°C

Fig. 2

Hordeum, summer barley
Plants are grown in climate rooms at 20°C
Stage: 50% of plants has ears
Measurement: last leaf but one, 25°C

Fig. 3

Hordeum, spring barley
Plants are grown in climate rooms at 20°C
Stage: just full grown
Measurement: last leaf but one, 25°C
Species: Lolium perenne 4N, ryegrass
Scientist: Th. Alberda
x pretreatment + TSC 15°C continue light, tap water
o " - TSC 30°C 2 hrs. light, nutrient solution
Measurement: 25°C, measured at sod.

Lolium perenne 4N
Pretreatment equal
TSC treatment during weekend
sod. A - TSC 30°C N.S. 2 hrs light
sod. B + TSC 15°C, tap water, continue light
Measurement: 25°C
Species: Lolium perenne (4N); ryegrass
Scientist: Th. Alberda
Pretreatment: climate room, 24 hrs per day light, 15°C, plants on water (+ TSC)
climate room, 2 hrs per day light, 30°C, plants on nutrient solution (½ Hoagland), (-TSC)
Measurement: sod; darkness, increasing light intensities, darkness, decreasing light intensities
Species: Chloris gayana; Rhodes grass
Scientist: Th. Alberda
Experiment: CO₂-assimilation in different assimilation chambers
Pretreatment: climate room 25°C
            light period 17 hrs; light intensity 0.08 cal cm⁻²min⁻¹
            nutrient solution † Hoagland
Age: 5-6 weeks
Measurement: I chamber includes only horizontal leaves
              II chamber includes shoots
              III chamber includes shoots plus roots plus root medium
Scientist: Th. Alberda

\[ \mu L \text{ CO}_2 \text{ cm}^{-2} \text{ hr}^{-1} \]

- 25°
- 20°
- 15°
- 10°

Cynodon dactylon sod.

- 49 -

\[ 200 \]
\[ 100 \]
\[ 0 \]
-200

\[ \text{cal cm}^{-2} \text{ min}^{-1} \]
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6

\[ \mu L \text{ CO}_2 \text{ cm}^{-2} \text{ hr}^{-1} \]

- 300
- 200
- 100
- 0
-100

Festuca rubra sod.

Scientist: Th. Alberda
Saccharum officinalis
2nd leaf, 20°C

Centaurium
20°C sod.
4 weeks planted

Limonium vulgare
20°C sod.

- 50 -
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<th></th>
<th>ug CO₂</th>
<th>uL CO₂</th>
<th>mol CO₂</th>
<th>mg CO₂</th>
<th>g CO₂</th>
<th>kg CO₂</th>
<th>kg CO₂</th>
<th>kg CH₂O**</th>
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<td></td>
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<td>cm⁻² hour</td>
<td>dm⁻² min</td>
<td>dm⁻ hour</td>
<td>m² hour</td>
<td>ha hour</td>
<td>ha hour</td>
<td>ha hour</td>
<td>ha day</td>
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<td>mg CO₂ cm⁻²</td>
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<td>0.552</td>
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<td>1.000</td>
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<td>14.55</td>
<td>1.000</td>
<td>2.64</td>
<td>0.264</td>
<td>2.64</td>
<td>63.4</td>
<td>1.80</td>
<td>43.2</td>
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<tr>
<td>mg CO₂ dm⁻²</td>
<td>10.000</td>
<td>5.52</td>
<td>0.379</td>
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<td>1.000</td>
<td>24.0</td>
<td>0.682</td>
<td>16.35</td>
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<td>g CO₂ m⁻²</td>
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<td>1.000</td>
<td>10.00</td>
<td>240.0</td>
<td>6.82</td>
<td>163.5</td>
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<tr>
<td>kg CO₂ ha hour</td>
<td>10.00</td>
<td>5.52</td>
<td>0.379</td>
<td>1.000</td>
<td>0.10</td>
<td>1.000</td>
<td>24.0</td>
<td>0.682</td>
<td>16.35</td>
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<tr>
<td>kg CO₂ ha day</td>
<td>0.417</td>
<td>0.230</td>
<td>0.01575</td>
<td>0.0417</td>
<td>0.00417</td>
<td>0.0417</td>
<td>1.000</td>
<td>0.0264</td>
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<tr>
<td>kg CH₂O** ha hour</td>
<td>14.67</td>
<td>8.10</td>
<td>0.535</td>
<td>1.467</td>
<td>0.1467</td>
<td>1.467</td>
<td>36.2</td>
<td>1.000</td>
<td>24.0</td>
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<tr>
<td>kg CH₂O** ha day</td>
<td>0.612</td>
<td>0.338</td>
<td>0.0232</td>
<td>0.0612</td>
<td>0.00612</td>
<td>0.0612</td>
<td>1.467</td>
<td>0.0417</td>
<td>1.000</td>
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* at 25°C, and 1 atm.
** these units should be avoided as much as possible
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<tr>
<th></th>
<th>cal cm(^{-2}) min(^{-1})</th>
<th>J m(^{-2})</th>
<th>J s(^{-1})</th>
<th>Ιουν n(^{2})</th>
<th>Ιουν n(^{2})</th>
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<th>Ιουν n(^{2})</th>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>infiltration</td>
<td>δ10 sec</td>
<td>550 nm</td>
<td>700 nm</td>
<td>2.57 × 10(^{-3})</td>
<td>2.57 × 10(^{-3})</td>
<td>7.70 l0-9</td>
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<tr>
<td>500 nm</td>
<td>4.29 10(^{-6})</td>
<td>2.09 10(^{-5})</td>
<td>2.09 10(^{-5})</td>
<td>0.059</td>
<td>0.059</td>
<td>0.059</td>
<td>0.059</td>
<td>0.059</td>
<td>0.059</td>
<td>1</td>
</tr>
<tr>
<td>750 nm</td>
<td>3.11 10(^{-6})</td>
<td>2.17 10(^{-5})</td>
<td>2.17 10(^{-5})</td>
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<tr>
<td>766 nm</td>
<td>2.24 10(^{-6})</td>
<td>1.71 10(^{-5})</td>
<td>1.71 10(^{-5})</td>
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List of measured species

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<td>Avena sativa; oats</td>
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<tr>
<td>Cannabis sativa; hemp</td>
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<tr>
<td>Carthamus tinctorius; safflower</td>
<td>6</td>
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<td>Centaurium minus</td>
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<td>Cucumus sativus; cucumber</td>
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<td>Cynodon dactylon</td>
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<td>Festuca rubra</td>
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<tr>
<td>Helianthus annuus; sunflower</td>
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<tr>
<td>Hordeum; summer &amp; spring barley</td>
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<tr>
<td>Lolium perenne; ryegrass</td>
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<td>Limonium vulgare</td>
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<tr>
<td>Phaseolus vulgaris; brown bean</td>
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<tr>
<td>Saccharum officinalis</td>
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<tr>
<td>Stipa capensis</td>
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<td>Triticum aestivum; wheat</td>
<td>42, 44</td>
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<tr>
<td>Zea mays; maize</td>
<td>5, 8, 9, 10, 12, 13, 14, 17, 18, 21, 23, 25, 31, 34, 37, 39</td>
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