

# Guide to Using Growth Chambers in the Phytotron



Last Updated: June 11/14

## E8 Growth Chambers

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### Specifications

All E8 growth chambers are equipped with Conviron CMP5000 series controllers. Data logging is available for environmental conditions (temperature and relative humidity) and can be accessed on the internet using the following link: <http://131.104.193.187:9001/?Folder=E8>.

Growth Area 0.74 m<sup>2</sup> (8 ft<sup>2</sup>)

Growth Height 116 cm (46")

Growth Capacity 900L (32 ft<sup>3</sup>)

Temperature range with lights OFF: 4 – 45 °C

Temperature range with lights ON: 10 – 45 °C

Combination of T12 fluorescent and incandescent lamps. Light levels depend on distance of plant canopy from the lamps, the age of the lamps, and the temperature in the chamber. An independent light sensor is available from the Coordinators if you wish to check your light levels during an experiment.

Relative Humidity - additive humidity is available, but temperature dependent. Consult with the Phytotron Coordinator.

Five E8s are available in the Phytotron. Two of the five have extended growth heights.

### Additional tips:

- Air flows in the chamber up through the floor, cooling first the plants, the air around and above the plants and finally the lights. To ensure even temperatures in the chamber, try not to block the entire floor with trays – open trays without holes (daisy baskets) will allow for the best airflow
- **The hole in the middle of the floor is NOT a drain** – this is where air is returned to the chamber's environmental sensors for sampling and ultimately decisions the chamber makes about heating/cooling, humidification etc. Do NOT block this hole. All chambers have additional tubes that fit in this hole, allowing you to adjust the position of air sampling. Ideally, you should sample at the height of your plant canopy.
- Watering can be performed in the chamber – there is a drain under the floor and all chambers are connected to floor drains. All electrical components and environmental sensors under the floor are protected. Take care not to get water down the hole in the middle of the floor described in the previous point – this will interfere with air sampling and environmental control
- If you are concerned about particular environmental conditions, specific alarms can be programmed as e-mail alerts to alert either the researcher or the Phytotron Coordinator about potential problems. Phytotron staff receive all notifications regarding temperature alarms as both e-mail alerts and phone calls.
- To minimize the effects of any environmental gradients inside the chamber on plant growth, we recommended that plant position in the growth chamber be randomized so that particular treatments are not spatially aggregated. A useful random number generator for randomizing plant positions in the chamber can be found at [www.random.org](http://www.random.org)
- For additional information about reporting environmental conditions for your growth chamber experiment see the following document: <http://www.controlledenvironments.org/Guidelines/Minimum-Guidelines-Brochure-version-A4.pdf>

## E15 Growth Chambers

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### Specifications

All E15s are equipped with Conviron CMP6000 series controllers, except one which is equipped with a CMP5000 series controller. Data logging is available for environmental conditions (temperature and relative humidity) and can be accessed on the internet using the following link:

<http://131.104.193.187:9001/?Folder=E15>.

Growth Area 1.4 m<sup>2</sup> (15 ft<sup>2</sup>)

Growth Height 116 cm (46")

Growth Capacity 1700L (60 ft<sup>3</sup>)

Temperature range with lights OFF: 4 – 45 °C

Temperature range with lights ON: 10 – 45 °C

Combination of T5 fluorescent and incandescent lamps. As of 2018, 5 of 6 E15 are equipped with full spectrum LED lights. Light levels depend on distance of plant canopy from the lamps, the age of the lamps, and the temperature in the chamber. An independent light sensor is available from the Coordinators if you wish to check your light levels during an experiment.

Relative Humidity - additive humidity is available, but temperature dependent. Consult with the Phytotron Coordinator.

Six E15s are available in the Phytotron. One of the six has extended growth height.

### Additional tips:

- Air flows in the chamber up through the floor, cooling first the plants, the air around and above the plants and finally the lights. To ensure even temperatures in the chamber, try not to block the entire floor with trays – open trays without holes (daisy baskets) will allow for the best airflow
- **The hole in the middle of the floor is NOT a drain** – this is where air is returned to the chamber's environmental sensors for sampling and ultimately decisions the chamber makes about heating/cooling, humidification etc. Do NOT block this hole. All chambers have additional tubes that fit in this hole, allowing you to adjust the position of air sampling. Ideally, you should sample at the height of your plant canopy.
- Watering can be performed in the chamber – there is a drain under the floor and all chambers are connected to floor drains. All electrical components and environmental sensors under the floor are protected. Take care not to get water down the hole in the middle of the floor described in the previous point – this will interfere with air sampling and environmental control
- If you are concerned about particular environmental conditions, specific alarms can be programmed as e-mail alerts to alert either the researcher or the Phytotron Coordinator about potential problems. Phytotron staff receive all notifications regarding temperature alarms as both e-mail alerts and phone calls.
- To minimize the effects of any environmental gradients inside the chamber on plant growth, we recommended that plant position in the growth chamber be randomized so that particular treatments are not spatially aggregated. A useful random number generator for randomizing plant positions in the chamber can be found at [www.random.org](http://www.random.org)
- For additional information about reporting environmental conditions for your growth chamber experiment see the following document: <http://www.controlledenvironments.org/Guidelines/Minimum-Guidelines-Brochure-version-A4.pdf>

## PGC20 Growth Chambers

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### Specifications

All PGC20s are equipped with Conviron CMP5000 series controllers. Data logging is available for all environmental conditions (temperature, relative humidity, light levels, and carbon dioxide) and can be accessed on the internet using the following link: <http://131.104.193.187:9001/?Folder=PGC20>.

Growth Area 1.9 m<sup>2</sup> (20 ft<sup>2</sup>)

Growth Height 157 cm (62")

Growth Capacity 3115L (110 ft<sup>3</sup>)

Temperature range with lights: OFF 4 – 40 °C

Temperature range with lights: ON 10 – 40 °C

Combination of T5 fluorescent and incandescent lamps. Fluorescent lamps use dimming ballasts and a quantum light sensor for precise control of light levels in the chamber.

Light range 0-1125  $\mu\text{mol}/\text{m}^2/\text{s}$  @ 15cm from canopy and 25 °C. Maximum light level can vary with distance of plant canopy from the lamps, the age of the lamps, and the temperature in the chamber.

Relative Humidity - additive humidity and dehumidification are both available, but temperature dependent. Consult with the Phytotron Coordinator.

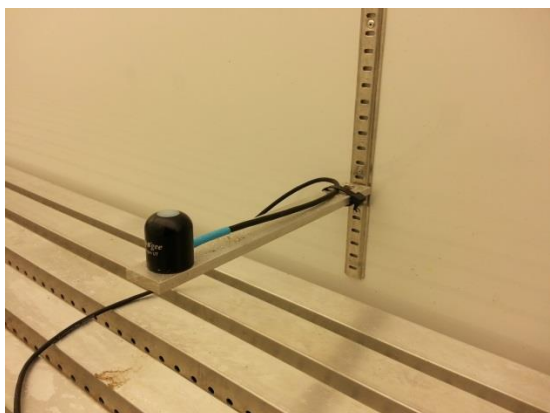
Additive carbon dioxide up to 3000 ppm. Below ambient concentrations (< 350 ppm) are possible, but require special set up. Consult with the Phytotron Coordinator.

18 PGC20s are available in the Phytotron. Two of the 18 use T8 fluorescent and incandescent lamps and have the ability to reach 4 °C with the lights ON, but do not have carbon dioxide control.

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### Additional tips:

- Air flows in the chamber up through the floor, cooling first the plants, the air around and above the plants and finally the lights. To ensure even temperatures in the chamber, try not to block the entire floor with trays – open trays without holes (daisy baskets) will allow for the best airflow. Using this method, plants can still be bottom watered by dipping daisy baskets into trays filled with water.
- Watering can be performed in the chamber – there is a drain under the floor and all chambers are connected to floor drains.



PGC20 Light Sensor

- **The light sensor in the PGC20 chambers controls the light output by making the lights brighter or dimmer as is necessary.** For example, if the PGC20 growth chamber is programmed for 150  $\mu\text{mol}/\text{m}^2/\text{s}$ , the light sensor will direct the chamber to make the lights brighter until the light sensor reads 150  $\mu\text{mol}/\text{m}^2/\text{s}$ . If the sensor becomes shaded for any reason (by leaves, pots, dirt, etc...) the light reading will not match the programmed level. The chamber will then attempt to increase the light output until the sensor reading matches the programmed light level. This situation could lead to your plants receiving up to 1000  $\mu\text{mol}/\text{m}^2/\text{s}$  rather than the programmed light level (in this example, 150  $\mu\text{mol}/\text{m}^2/\text{s}$ ). **To ensure accurate light levels in the chamber, it is extremely important that you do not shade the light sensor!!!**

- **The light sensor should be kept just above the plant canopy, in a level, horizontal position.** There is a track along the back wall that will allow the sensor to be moved higher as the plants grow. **This will ensure consistent light levels at the plant canopy.**



**PGC20 aspirator**

- The white box inside the growth chamber (also known as the aspirator) contains the chamber temperature sensor and relative humidity sensor along with a circulating fan. Take care not to get the box wet as moisture will damage the fan and the relative humidity sensor.
- The aspirator should also be kept at the level of the plant canopy to ensure accurate environmental measurements and good environmental control.
- If you are concerned about particular environmental conditions, specific alarms can be programmed to alert either the researcher or the Phytotron Coordinator about potential problems. For example, if it was desired to keep carbon dioxide levels above 2000ppm, an alarm can be set to alert researchers or staff if CO<sub>2</sub> levels fell below that threshold (e-mail alerts can be programmed for any researcher from any chamber).
- To minimize the effects of any environmental gradients inside the chamber on plant growth, we recommended that plant position in the growth chamber be randomized so that particular treatments are not spatially aggregated. A useful random number generator for randomizing plant positions in the chamber can be found at [www.random.org](http://www.random.org)
- For additional information about reporting environmental conditions for your growth chamber experiment see the following document: <http://www.controlledenvironments.org/Guidelines/Minimum-Guidelines-Brochure-version-A4.pdf>

## PGV36 Growth Chambers

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### Specifications

All PGV36s are equipped with Conviron CMP5000 series controllers. Data logging is available for all environmental conditions (temperature, relative humidity, light levels, and carbon dioxide) and can be accessed on the internet using the following link: <http://131.104.193.187:9001/?Folder=PGV36>.

Growth Area 3.3 m<sup>2</sup> (36 ft<sup>2</sup>)

Growth Height 204 cm (80.25")

Growth Capacity 6700L (240 ft<sup>3</sup>)

Temperature range with lights: OFF 4 – 45 °C

Temperature range with lights: ON 10 – 40 °C

Combination of T5 fluorescent and incandescent lamps. Fluorescent lamps use dimming ballasts and a quantum light sensor for precise control of light levels in the chamber.

Light range 0-1125  $\mu\text{mol}/\text{m}^2/\text{s}$  @ 15cm from canopy and 25 °C. Maximum light level can vary with distance of plant canopy from the lamps, the age of the lamps, and the temperature in the chamber.

Relative Humidity - additive humidity and dehumidification are both available, but temperature dependent. Consult with the Phytotron Coordinator.

Additive carbon dioxide up to 3000 ppm. Below ambient concentrations (< 350 ppm) are possible, but require special set up. Consult with the Phytotron Coordinator.

4 PGV36s are available in the Phytotron.

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### Additional tips:

- Air flows in the chamber up through the floor, cooling first the plants, the air around and above the plants and finally the lights. To ensure even temperatures in the chamber, try not to block the entire floor with trays – open trays without holes (daisy baskets) will allow for the best airflow. Using this method, plants can still be bottom watered by dipping daisy baskets into trays filled with water.
- The hole in the middle of the floor is NOT a drain – this is where air is returned to the chamber's environmental sensors for sampling and ultimately decisions the chamber makes about heating/cooling, humidification etc. Do NOT block this hole. All chambers have additional tubes that fit in this hole, allowing you to adjust the position of air sampling. Ideally, you should sample at the height of your plant canopy.



PGV36 Light Sensor

- Watering can be performed in the chamber – there is a drain under the floor and all chambers are connected to floor drains. Take care not to get water down the hole in the middle of the floor described in the previous point – this will interfere with air sampling and environmental control

- **The light sensor in the PGV36 chambers controls the light output by making the lights brighter or dimmer as is necessary.** For example, if the PGV36 growth chamber is programmed for 150  $\mu\text{mol}/\text{m}^2/\text{s}$ , the light sensor will direct the chamber to make the lights brighter until the light sensor reads 150  $\mu\text{mol}/\text{m}^2/\text{s}$ . If the

sensor becomes shaded for any reason (by leaves, pots, dirt, etc...) the light reading will not match the programmed level. The chamber will then attempt to increase the light output until the sensor reading matches the programmed light level. This situation could lead to your plants receiving up to 1000  $\mu\text{mol}/\text{m}^2/\text{s}$  rather than the programmed light level (in this example, 150  $\mu\text{mol}/\text{m}^2/\text{s}$ ). **To ensure accurate light levels in the chamber, it is extremely important that you do not shade the light sensor!!!**

- **The light sensor should be kept just above the plant canopy, in a level, horizontal position.** There is a track along the back wall that will allow the sensor to be moved higher as the plants grow. **This will ensure consistent light levels at the plant canopy.**
- If you are concerned about particular environmental conditions, specific alarms can be programmed to alert either the researcher or the Phytotron Coordinator about potential problems. For example, if it was desired to keep carbon dioxide levels above 2000ppm, an alarm can be set to alert researchers or staff if  $\text{CO}_2$  levels fell below that threshold (e-mail alerts can be programmed for any researcher from any chamber).
- To minimize the effects of any environmental gradients inside the chamber on plant growth, we recommended that plant position in the growth chamber be randomized so that particular treatments are not spatially aggregated. A useful random number generator for randomizing plant positions in the chamber can be found at [www.random.org](http://www.random.org)
- For additional information about reporting environmental conditions for your growth chamber experiment see the following document: <http://www.controlledenvironments.org/Guidelines/Minimum-Guidelines-Brochure-version-A4.pdf>

## GR64 and GR192 Growth Rooms

### Specifications

All GR64 and GR192 growth rooms are equipped with Conviron CMP4000 series controllers. Data logging is available for environmental conditions (temperature and relative humidity) and can be accessed on the internet using the following link: <http://131.104.193.187:9001/?Folder=GR64> and <http://131.104.193.187:9001/?Folder=GR192>

Growth Area GR64 5.9 m<sup>2</sup> (64 ft<sup>2</sup>) GR192 17.8 m<sup>2</sup> (192 ft<sup>2</sup>)

Growth Height GR64 203 cm (80") GR192 203 cm (80")

Growth Capacity GR64 11,980 L (420 ft<sup>3</sup>) GR64 36,000 L (1280 ft<sup>3</sup>)

Temperature range with lights OFF: 5 – 25 °C

Temperature range with lights ON: 15 – 35 °C

Combination of T8 fluorescent lamps, compact fluorescent lamps and incandescent lamps in the GR64s. Combination of T12 fluorescent lamps, compact fluorescent lamps and incandescent lamps in the GR192s, with retrofits planned to update the lamps to T8. Light levels depend on distance of plant canopy from the lamps, the age of the lamps, and the temperature in the chamber. An independent light sensor is available from the Coordinators if you wish to check your light levels during an experiment.

Relative Humidity - additive humidity is available in 2 of the GR192 rooms, but temperature dependent. Consult with the Phytotron Coordinator.

Five GR64s are available in the Phytotron. One of the five GR64s is used as a Tissue Culture room. Three GR192s are available in the Phytotron.

### Additional tips:

- Air flows in the room down from the fan units hanging from the ceiling, running down the middle of the rooms. The air goes down towards the floor, cooling first the plants, the air around and above the plants and finally the lights. To ensure even temperatures in the room, nothing should be left in the middle aisle way underneath the fans. In addition, if benches are present in the room, they should be pulled about 10cm away from the back walls to ensure good airflow.
- Watering can be performed in the room – there is a drain at one end of each room. If water is not flowing towards the drain, Phytotron staff can provide a floor squeegee to assist with moving water towards the drain.



Growth room aspirator

- The white box inside the growth room (also known as the aspirator) contains the chamber temperature sensor and relative humidity sensor along with a circulating fan. Take care not to get the box wet as moisture will damage the fan and the relative humidity sensor.
  - The aspirator should also be kept at the level of the plant canopy to ensure accurate environmental measurements and good environmental control.
  - If you are concerned about particular environmental conditions, specific alarms can be programmed as e-mail alerts to alert either the researcher or the Phytotron Coordinator about



potential problems. Phytotron staff receive all notifications regarding temperature alarms as both e-mail alerts and phone calls.

- To minimize the effects of any environmental gradients inside the chamber on plant growth, we recommended that plant position in the growth chamber be randomized so that particular treatments are not spatially aggregated. A useful random number generator for randomizing plant positions in the chamber can be found at [www.random.org](http://www.random.org)
- For additional information about reporting environmental conditions for your growth chamber experiment see the following document: <http://www.controlledenvironments.org/Guidelines/Minimum-Guidelines-Brochure-version-A4.pdf>