Vötsch
Industrietechnik

# Nature Sets the Standards

## Plant Growth Cabinets and Plant Growth Walk-In Chambers



VIT-E 70000

*Bio Line*, the system which has been developed "by biologists for biologists". It was created in cooperation with scientists from many different fields of research. Biological aspects, research diversity along with easy operation and cleansing as well as maintenance friendliness have been considered during the development of this line. Thus, *Bio Line* chambers are especially adapted to modern experimental practice in the field of natural science.

Modularity - the concept of *Bio Line*. The system consists of three types of modules: a research room, an electro and machine module and a variety of functional modules. The research room is available in three sizes. The functional modules, e.g. different irradiation intensities, temperature, air flow and height modules adapt the research room to suit not only your experiments but also your plants. Should your research requirements change then *Bio Line* adapts itself to the new requirements by exchanging or retrofitting individual functional modules.

*Bio Line* offers natural horizontal air flow. An innovative fine pored airflow fiber made of polypropylene ensures not only extremely low air velocity rates in the research room but also high climate constancy.

The low air velocity rate in the *Bio Line* research rooms supports a more natural evaporation rate of the stomata without water stress.

Thanks to its special fibrous structure, the fiber is microbiologically and physiologically safe and very easy to clean.

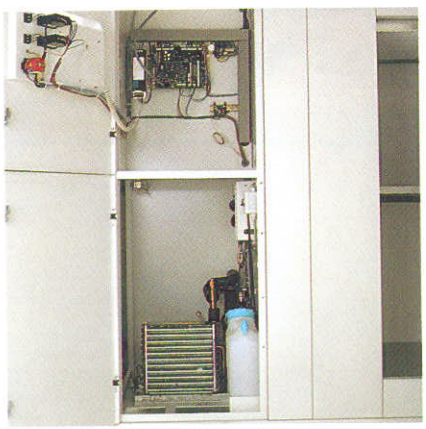

Fig. 1: Machine module - good access from the front

Fig. 2: *Bio Line* cabinets VB 1014 and VB 1514

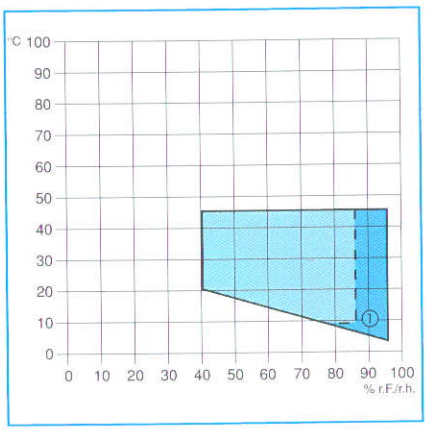


Fig. 3: Humidity range
1 = range inapplicable with irradiation

*Bio Line* - the space saving concept. Access, operation and maintenance from the front. To facilitate service work, the electro and machine module and the connections are accessible via large doors. Power and water connections are easy to connect. Several systems may be installed in one row, shoulder to shoulder, without a gap between them.
An innovative humidification system creates germ-free vapour of approx. +150 °C, thanks to shock heated stream. Protein molecules on contaminantes denature immediately. This low-maintenance system is operated with demineralized water. A highly efficient separate dehumidification exchanger provides a constant climate.

Excellent accessibility to the research room is provided thanks to large doors with observation windows. Door and window flaps close light-tight. The *Bio Line* research room may be easily cleaned from chemical and micro-biological contamination.

*Bio Line* does not use materials which contain substances proven to be phytotoxic. The polymeric materials assigned in the research room have been gas-chromatographically analyzed for volatile organic emissions.

The research room is made of insulated elements and is sealed vapour-tight. The insulation material ensures excellent heat insulation which contributes to high constancy of climate conditions and to the reduction of operating costs.

Highly reflecting surfaces create a natural scattering of rays and thus extremely uniform irradiation is achieved over the entire research room.

*Bio Line* uses the chlorine-free refrigerant. Ozone depletion potential is thus reduced to zero. The insulating material is 50 mm pure mineral fiber which is free from CFC and asbestos.

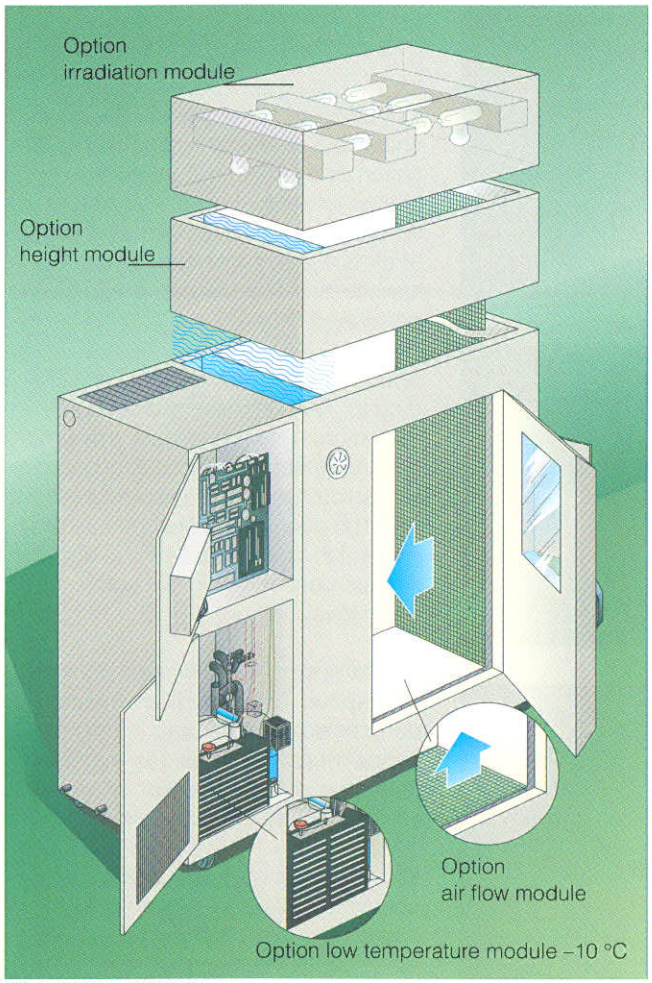


*Fig. 4: Scheme - modularity*

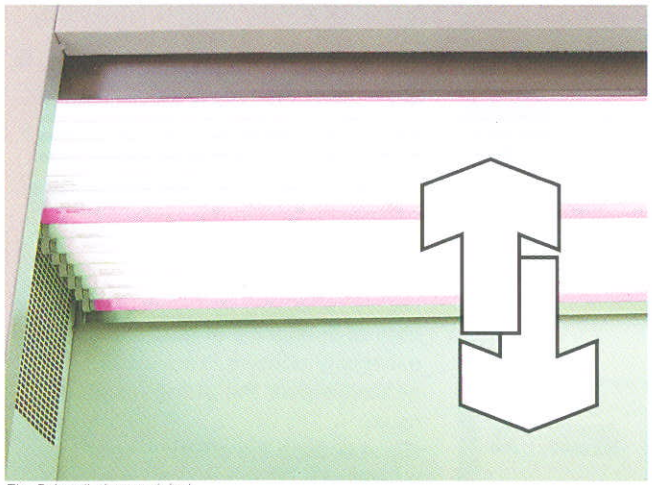

*Fig. 5: Irradiation module 1*

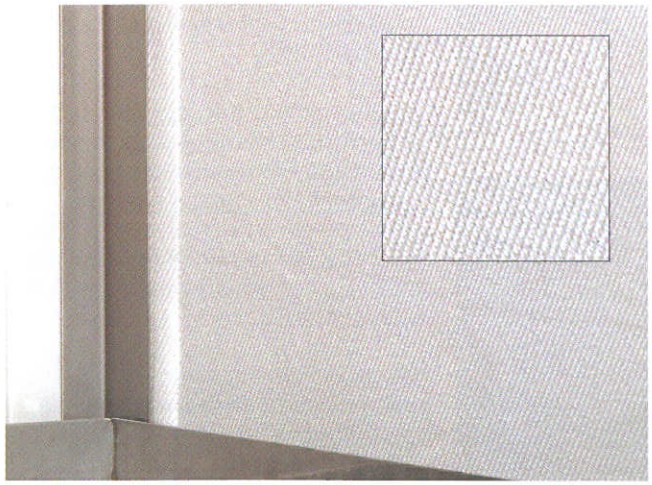

*Fig. 6: Airflow-fiber*

# Technical Data *Bio Line* Cabinets

| **Type** | | **Fig. 2*** | **VB 0714** | **VB 1014*** | **VB 1514*** |
|---|---|---|---|---|---|
| Ordering code: | | | 77100 | 77300 | 77500 |
| Research room | area | $m^2$ | 0.7 | 1.0 | 1.5 |
| Dimensions | width | mm | 970 | 1270 | 1990 |
| | depth | mm | 750 | 750 | 750 |
| | height | mm | 1400 | 1400 | 1400 |
| **Climate** | | **Fig. 3** | sterile steam humification | | |
| Temperature range | | °C | +5 to + 45, without irradiation | | |
| | | °C | +10 to +45, with irradiation | | |
| Temperature fluctuation | | K | ± 0.5 temporally | | |
| Humidity range | | %r.h. | 40 to 95, without irradiation | | |
| | | %r.h. | 40 to 85, with irradiation | | |
| Humidity fluctuation | | % r.h. | ± 3 to 5, temporally | | |
| Dew point range | | °C | +4 to +35 | | |
| **Irradiation module 1** | | **Fig. 5** | adjustable in height | | |
| Intensity | | µmol/$m^2$s (klx) | 450 (35) | | |
| Distance | | mm | 200 | | |
| Day/night cycle | | | 6 steps | | |
| Lamp type | | **Fig.7/8** | fluorescent tubes | | |
| **Air flow module 1** | | **Fig. 6** | horizontal with airflow fiber | | |
| **Communications module** | | | | | |
| Terminal | | **Fig. 11** | C-terminal | | |
| Programming | | | real time | | |
| Interface | | | RS 232 | | |
| Exterior dimensions | width | mm | 1980 | 2280 | 3000 |
| (without door) | depth | mm | 850 | 850 | 850 |
| | height | mm | 1970 | 1970 | 1970 |
| Door | width x height | mm | 900 x 1400 | | 2x900x1400 |
| Observation window | WxH | mm | 400 x 700 | | 2x400x700 |
| Nominal voltage | | | 400 V +6/-10%, 3/N, 50 Hz | | |
| Nominal power | | kW | 3.0 | 3.3 | 4.0 |

## Options

| **Irradiation module 2** | | **Fig. 4** | separate lamp compartment, air-cooled | | |
|---|---|---|---|---|---|
| Intensity | | µmol/$m^2$s (klx) | 700 (50) | | |
| Distance | | mm | 500 | | |
| Day/night cycle | | | 6 steps | | |
| Lamp type | | **Fig. 9** | metal-halide lamps + krypton | | |
| Nominal voltage | | | 400 V, +6/-10 %, 3/N, 50 Hz | | |
| Nominal power | | | 4.5 | 5.3 | 7.0 |
| **Irradiation module 3** | | **Fig. 4** | separate lamp compartment, air-cooled | | |
| Intensity | | µmol/$m^2$s (klx) | 1000 (71) | | |
| Distance | | mm | 500 | | |
| Day/night cycle | | | 6 steps | | |
| Lamp type | | **Fig. 9** | metal-halide lamps + krypton | | |
| Nominal voltage | | | 400 V, +6/-10 %, 3/N, 50 Hz | | |
| Nominal power | | kW | 6.0 | 7.8 | 10.5 |
| **Height module** | | **Fig. 4** | height extension by 500 mm | | |
| **Air flow module 2** | | **Fig. 4** | vertical, over perforated floor | | |
| **Low temperature module** | | **Fig. 4** | -10 to +45 °C,without irradiation | | |
| UV irradiation | | **Fig. 10** | on request | | |
| Software TSI | | **Fig. 12** | DOS or OS2 | | |
| $CO_2$ measuring and dosing unit | | | on request | | |

Performance values refer to 25 °C ambient temperature, without test material, without options - We reserve the right of changes in construction resulting from technical progress.

Spectra have been selected according to PAR (Photosynthetic Active Radiation). The combination of different lamps simulate a spectrum similar to that of daylight. The natural simulation of a day is achieved by the discontinuous control of six irradiation intensities. Dawn and dusk are simulated by a separate irradiation intensity which has a high proportion of red light (phytochrome).

The irradiation module 1 - Fig. 5 (450 µmol/m²s at a distance of 200 mm) is equipped with fluorescent lamps which are infinitely variable in height. Adjustable from the outside via an electromotor, the experimental conditions remain constant and undisturbed.

*Bio Line* offers two other irradiation variations for every size of research room: 700 and 1000 µmol/m²s at a distance of 500 mm (e.g. for $C_4$ plants). The metal-halide lamps (Fig. 9) are installed in a separate air-cooled lamp compartment. The climate remains constant. Lamps may be easily replaced.

UV radiation (option - Fig. 10) is possible upon request.

Programming of a day/night cycle e.g. short day term or long day term is performed menue-guided in real-time mode with the C-terminal or PC. The microprocessor control monitors the functioning of the system. Faults are displayed on the LCD display of the C-terminal (Fig. 11).

32 systems may be programmed and controlled with the option TSI (Test System Interconnection, Fig. 12). Programmes and research conditions are documented and are graphically displayed. Control limits may be selected.

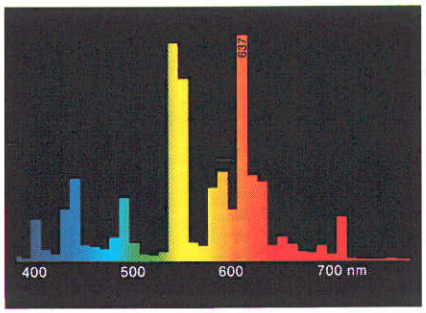

Fig. 7: Fluorescent lamps - LUMILUX®

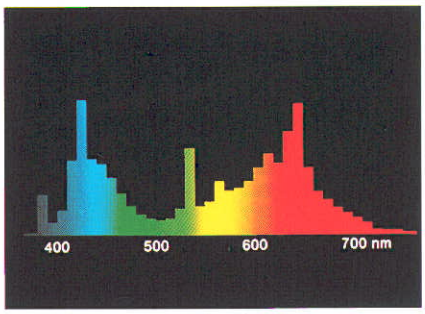

Fig. 8: Fluorescent lamps Fluora®

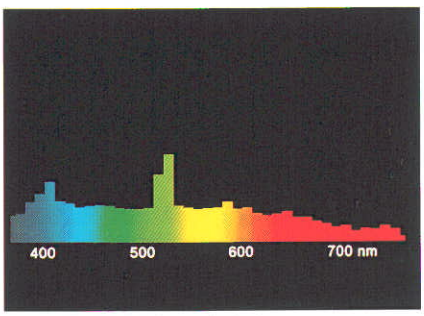

Fig. 9: Metal-halide lamps (option)

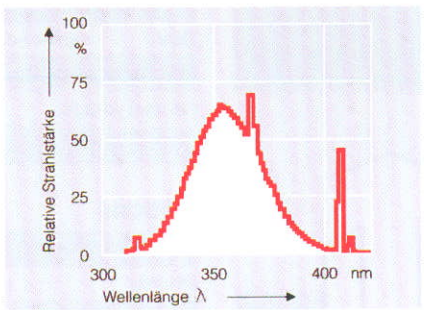

Fig. 10: UV-radiation (option)

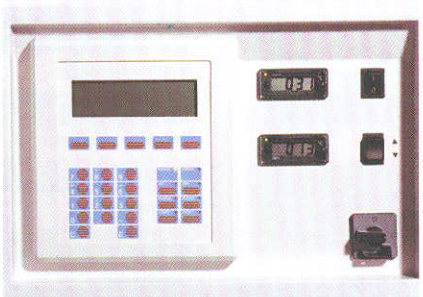
Fig. 11: C-terminal


Fig. 12: TSI-Software (DOS) (option)

# Walk-in Chambers

The concept of the walk-in *Bio Line* chambers is also based on the application orientated modularity. Irradiation intensity, growth height and temperature range as well as the type of air flow can be chosen freely. The standard air flow version is vertical via perforated floor.

Spectra have been selected according to PAR (Photosynthetic Active Radiation). Dawn and dusk are simulated by a separate irradiation intensity which has a high proportion of red light (phytochrome). Natural spectral simulation is achieved by the discontinuous control of six irradiation intensities.

Humidification is performed with sterile vapour. The humidifier requires demineralized water and is maintenance-friendly. A separate, high performance dehumidification system ensures stable climate conditions.

*Bio Line* does not use materials which contain substances proven to be phytotoxic. The polymeric materials assigned in the research room have been gas-chromatographically analyzed for volatile organic emissions.

The research room is made of insulated elements and is sealed vapourtight. The insulation material ensures excellent heat insulation which contributes to high constancy of climate conditions and to the reduction of operating costs.

Highly reflecting surfaces create a natural scattering of rays and thus extremely uniform irradiation is achieved over the entire research room.
*Bio Line* uses the chlorine-free refrigerant. Ozone depletion potential is thus reduced to zero. The insulating material is 75 mm PU-foam which is free from CFC.

Programming of the day/night rhythm is performed menue-guided in real-time mode with the C-terminal (Fig.11) - see control unit of the cabinets. Horizontal air flow (option) with airflow fiber ensures low air velocity and high constancy of climate conditions in the research room.

*Bio Line* offers a system of options with various functional modules e.g. the irradiation modules and the air flow modules.

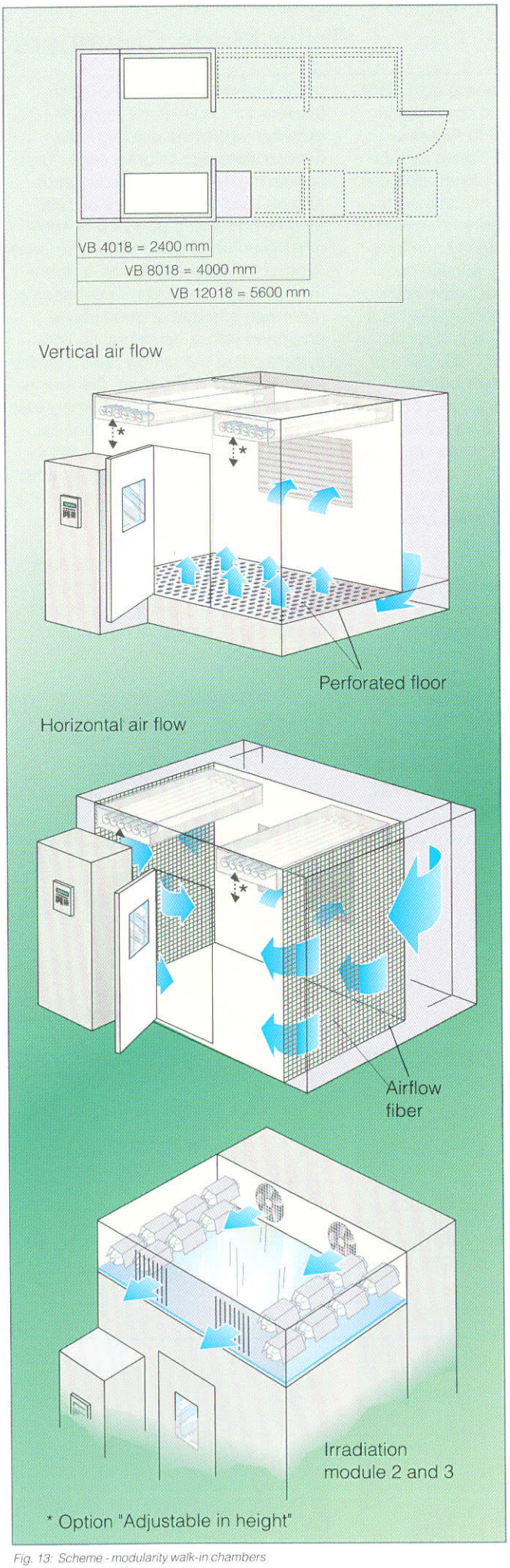


Fig. 13: Scheme - modularity walk-in chambers

# Technical Data

## *Bio Line* Walk-in Chambers

| Type | | VB | 4018 | 8018 | 12018 |
|---|---|---|---|---|---|
| Research room, area | | $m^2$ | 4.0 | 8.0 | 12.0 |
| Dimensions | width | mm | 2550 | 2550 | 2550 |
| | depth | mm | 1630 | 3230 | 4830 |
| | height | mm | 1800 | 1800 | 1800 |
| **Climate** | | **Fig. 3** | sterile steam humification | | |
| Temperature range | | °C | +5 to + 45, without irradiation | | |
| | | °C | +10 to +45, with irradiation | | |
| Temperature fluctuation | | K | ± 0.5 temporally | | |
| Humidity range | | %r.h. | 40 to 95, without irradiation | | |
| | | %r.h. | 40 bis 85, with irradiation | | |
| Humidity fluctuation | | % r.h. | ± 3 to 5, temporally | | |
| Dew point range | | °C | +4 to +44 | | |
| **Irradiation module 1** | | | stationary lamp frame | | |
| Intensity | | µmol/$m^2$s (klx) | 450 (35) | | |
| Distance | | mm | 200 | | |
| Day/night cycle | | | 6 steps | | |
| Lamp type | | **Fig.7/8** | fluorescent tubes | | |
| **Air flow module 1** | | | vertical, via perforated floor | | |
| **Communications module** | | | | | |
| Terminal | | **Fig. 11** | C-terminal | | |
| Programming | | | real time | | |
| Interface | | | RS 232 | | |
| Exterior dimensions | width | mm | 2700 | 2700 | 2700 |
| | depth | mm | 2400 | 4000 | 5600 |
| | height | mm | 2495 | 2495 | 2495 |
| Door | width x height | mm | 800 x 1900 | | |
| Threshold | | mm | 395 | | |
| Observation window | WxH | mm | 400 x 400 | | |
| Separate control unit | WxDxH | mm | 800 x 600 x 2100 | | |
| Nominal voltage | | | 400 V, +6/-10 %, 3/N, 50 Hz | | |
| Nominal power | | kW | 8 | 15 | 25 |

## Options

| | | | |
|---|---|---|---|
| **Irradiation module 1 / variant** | | adjustable in height | |
| **Irradiation module 2 *** | | separate lamp compartment, air-cooled | |
| Intensity | µmol/$m^2$s (klx) | 700 (50) | |
| Distance | mm | 500 | |
| Day/night cycle | | 6 steps | |
| Lamp type | **Fig. 9** | metal-halide lamps + krypton | |
| Nominal power | kW | 12 | 20 | 28 |
| **Irradiation module 3 *** | | separate lamp compartment, air-cooled | |
| Intensity | µmol/$m^2$s (klx) | 1000 (71) | |
| Distance | mm | 500 | |
| Day/night cycle | | 6 steps | |
| Lamp type | **Fig. 9** | metal-halide lamps + krypton | |
| Nominal power | kW | 17 | 30 | 41 |
| **Height module 1** | | height extension by 300 mm | |
| **Height module 2** | | height extension by 600 mm | |
| **Air flow module 2** | | horizontal with airflow fiber exterior dimensions in width + 300 mm, in height - 300 mm, threshold 95 mm | |
| **Low temperature module** | | -10 to +45 ° C, without irradiation | |
| UV irradiation | | on request | |
| $CO_2$ measuring and dosing unit | | on request | |
| shelf systems | | on request | |
| Software TSI | **Fig. 12** | DOS or OS2 | |

* The exterior dimension is 3095 mm - Performance values refer to 25 °C ambient temperature, without test material, without options - We reserve the right of changes in constructions resulting from technical progress.

# Tailor-Made Chambers

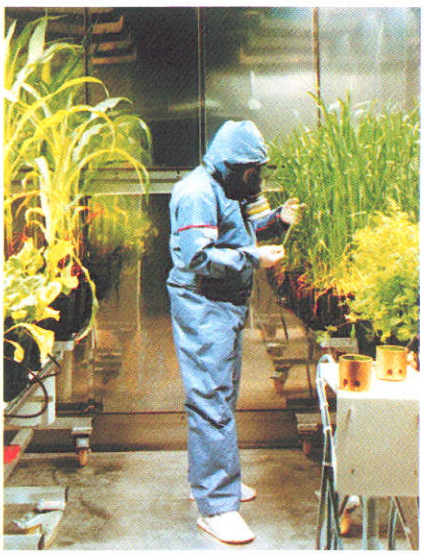

Fig. 14: Title - Walk-in chamber at BASF

The cover picture of this brochure shows the agricultural research station at the Ecobiology Division of BASF, Limburgerhof. Data for the registration of pesticides corresponding to EPA and BBA guidelines (with $_{14}C$ pesticides) is gained here. The results from phytotron and field studies are almost identical. The climate and daylight conditions prevailing in the countries of the five continents with their respective seasonal and diurnal cycles, wind and $CO_2$ concentration (350 ppm) are simulated. Sunlight is simulated by a xenon reflector-filter system. Programming, control and documenting is performed centrally via computer.

The plants under research include corn, potatoes, rape, rice, soya, tobacco, tomatoes and wheat.

Literature:
"Climate Simulation for Studies on Fate of Pesticides in Plants", 8. IUPAC, Washington D.C., USA 1994

In the exposition chambers at the GSF conditions prevailing in the Bavarian Alps from Spring 1986 to Autumn 1987 were simulated. Forest decline was investigated with cloned spruces. Seasonal and diurnal rhythms were performed in the temperature range of +26 °C to -14 °C and in the humidity range of 25 % to 98 % relative humidity. The maximum irradiation intensity amounted to 1200 µmol/m²s PAR in a distance of 1000 mm. The chamber was exposed to ozone (130-360 mg/m³). The wind speed reaches to 0.6 m/s. Acid rain was set to a pH value of 3 or 5.6. The area surrounding the roots of the spruces was tempered between +2 °C and +14 °C. Fresh air and discharge air were cleansed with partical filters and activate carbon filters.

The plants under research include beech trees, oak trees, spruces, tobacco, tomatoes and wheat.

Literature:
"Effects of Ozone, Acid Mist and Soil Characteristics on Clonal Norway Spruce - An Introduction to the Joint 14 Month Tree Exposure Experiment in Closed chambers", Environmental Pollution 64 (1990) 189-207.

Fig. 15 and 16 : Exposition chambers at the Research Center for Environment and Health, GSF, Munich

In the phytotron of the Max-Planck-Institute for Cultivation Research high growing teosinthes coming from Mexico mature to inflorescence. The spectrum of the metal-halide lamps and an irradiation intensity of 1200 µmol/m²s PAR in a distance of 1000 mm make "nicking" possible. Programming of the day/night cycle is performed in real-time mode. The research room with a height of 3000 mm is equipped with a horizontal air flow system using the airflow fiber. Thanks to its fine-pored structure, the innovative airflow fiber makes extremely low air rates and high constancy of the climate possible. This fiber is microbiologically and physiologically safe. Natural evaporation behaviour on the stomata is preserved.

Since 1994, this type of airflow fiber has been successfully applied in seven phytotrons at the Max-Planck Institute for Cultivation in Cologne.

Fig. 17: Max-Planck-Institute for Cultivation Research

Fig. 18: Max-Planck-Institute for Cultivation Research

Fig. 19/20: Study Chair of Phytopathology, University of Constance

Experiments are being conducted at the University of Constance with phytopathological fungi e.g. rusts. For inoculation of the plant host, a temperature range of +16 °C to +22 °C and saturated air over a period of 8 hours is necessary. A system of binary nozzles creates 100 % relative humidity in the research room. Decontamination and safety devices are absolutely essential. The research room made of stainless steel may be disinfected with gaseous formaldehyde. The climatic system is cleansed by an additional thermal disinfection system. Filters, Class S (DIN 29 184) with an efficiency of at least 99.97 % clean the discharge air. Underpressure in the research room prevents phytopathogene spores from escaping when the opening of the door.

Fig. 21/22: Department of Genetic Research of Higher Plants, Technical University of Munich

The Study Chair for the Genetic Research on Higher Plants is working on the establishment of barley transformation. The effects of transposable DNA elements and their application in plant genetics as well as the expression of plant proteins in heterologic plant systems are investigated. The rack system with illuminated shelves not only offers adequate irradiation but also a great deal of space. The correct spectrum is achieved by a combination of lamps.

Research cultures are tobacco and Arabidopsis tissue cultures arising from Agrobacterium tumefaciens, embryogene callus cultures of barley arising from particle bombardment.


Fig. 23/24: Biophysic Study Group, Technical University of Munich

The Biophysics Study Group of the Technical University of Munich investigated photosynthesis and the water content of agricultural plants e.g. of spring-sown wheat. The challenge was to simulate open land conditions in the laboratory. Realistic field conditions with wind speeds of 3 m/s are simulated in both research rooms. A $CO_2$ measuring and dosing system is available. Both chambers are connected via TSI software. Programming, control and documentation of "Otto" and "Else" - the code names of the chambers - are performed centrally via PC.

Literature:
"Simulation of Natural Weather Conditions in Climate Chambers: Possibilities and Limits", Garden Science, 59 (2), Pages 89-94, 1994.

We reserve the right of changes in constructions resulting from technical progress.
Figures partly with options.

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