

THE JOENSUU DASOTRONS: A NEW FACILITY FOR STUDYING SHOOT, ROOT AND SOIL PROCESSES



L. Finér¹, P. Aphalo², U. Kettunen¹, H. Mannerkoski², T. Repo² & J. Öhman³

¹ Finnish Forest Research Institute, Joensuu Research Station, P. O. Box 68, 80101 Joensuu, Finland;

² University of Joensuu, Faculty of Forestry, P. O. Box 111, 80101 Joensuu, Finland;

³ Arctest Ltd., P. O. Box 15, 02761 Espoo, Finland

Abstract

A new facility was built in Joensuu, Finland, during 1996-1998 in order to be able to control soil temperature separately from air temperature, and to have enough soil and air space in which long term experiments, e.g. lasting for several growing seasons, can be carried out with trees.

General description

The facility consists of four rooms (RTR48, Conviron) called dasotrons where air and soil temperature, air humidity and photon flux density can be controlled independently. The floor area of the rooms is 9.7 m² and volume 60.9 m³. The doors, walls and ceilings of the rooms are insulated and the inner wall is faced with aluminium sheeting painted white. The surface material of the floors is grey-painted concrete. Each room has inlets for tap water, deionised water, electricity and pressurized air and an outlet for waste water.

Each dasotron contains four cylindrical pots (Arctest) with a removable upper half. The maximum height of plant shoots is 3.1 m. The walls of the pots are insulated and made of black polythene. There are access holes in the walls of the pots for the installation of sensors and minirhizotron tubes. There is a drain, with valves at the bottom of the pots for the removal of excess water from the pots or the collection of percolation water if required. A water table can be maintained in the pots. The pots can be filled with either organic or mineral soil, or combinations of the two. Irrigation and fertilization of plants takes place manually.

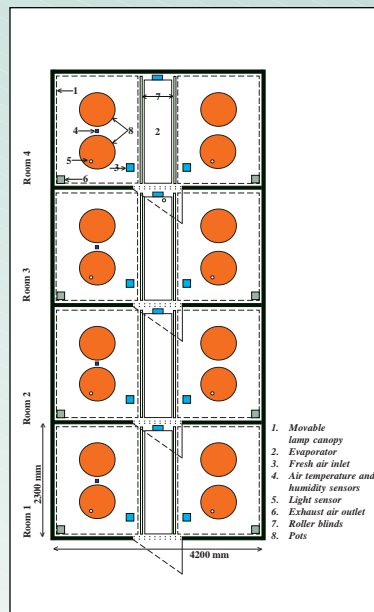


Fig 1. Top view of the dasotrons.

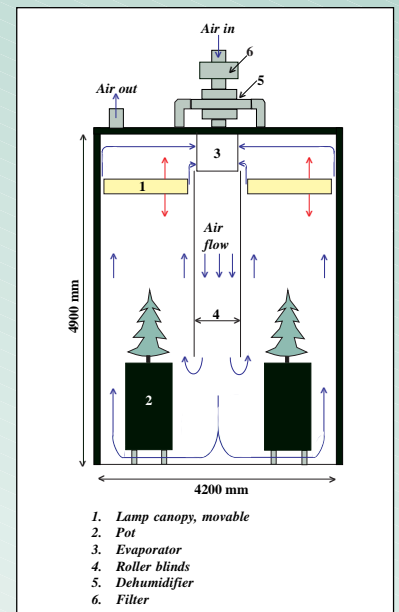


Fig 2. Side view of the dasotron.

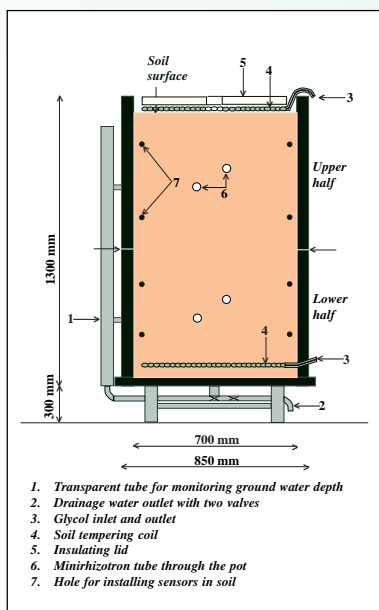


Fig 3. Side view of a pot.



Photo 1. A pot in which a Norway spruce seedling has been grown for two growing seasons.

Operation

Air temperature can be controlled from +1 °C to +40 °C when the lights are off, and from +10 °C to +40 °C when the lights are on. Air humidity can be controlled within the range 37%-80% when the lights are on, and within the range 37-90% when the lights are off. Lighting is provided by means of a combination of 250 W high pressure sodium and metal halide lamps with a maximum of 4000 W in each lamp canopy. The photon flux density can be controlled at five levels from 0 up to 850 mmol m⁻² s⁻¹. Filtered fresh air is supplied through the ceiling of each room at a maximum rate of 50 l s⁻¹.

Soil temperature in the upper and lower parts of the pots can be regulated separately from -5 °C to +40 °C and from +1 °C to +40 °C, independently of the air temperature. Soil temperature is controlled by circulating glycol brine inside two stainless steel coils.

Programming of the parameters in the rooms can be done locally (CMP4030) or through a central control system (CMP4000) running on a personal computer.

We have been using the facility since the beginning of June 1998 to study the effects of soil temperature on the shoots and roots of birch (*Betula pendula* Roth) and Norway spruce (*Picea abies* Karsten). The dasotrons have operated for most of the time as planned, air temperature and humidity especially have remained well within the specifications. In general the facility has been reliable and we have found that it provides an excellent environment for ecophysiological studies on the effects of environmental changes on the mechanisms involved in soil-root-shoot systems.